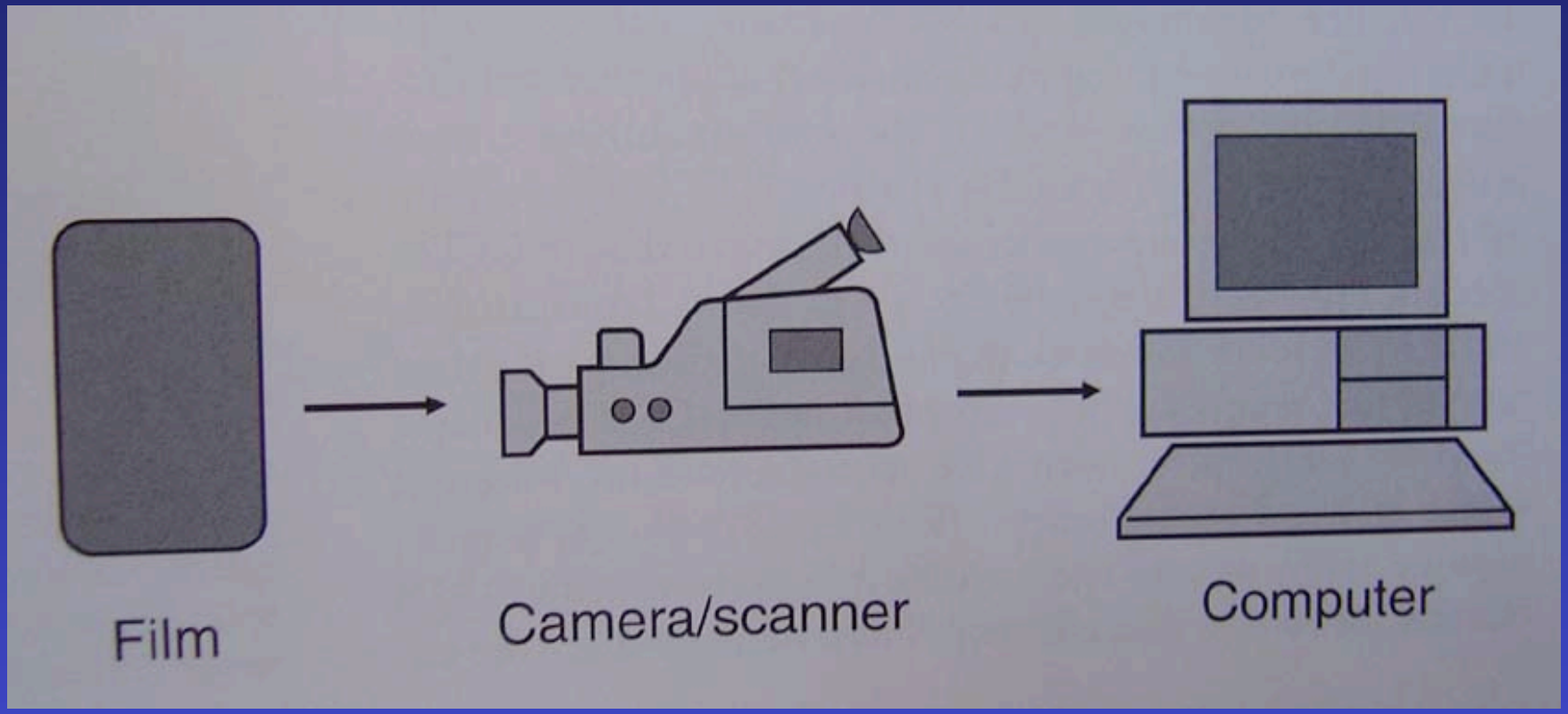
Digital imaging systems

Dr.Gábor Ackermann

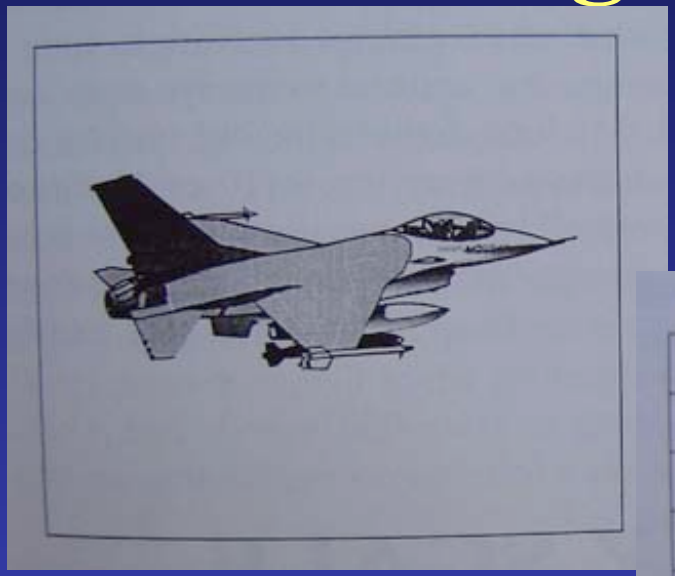
www.dentesthic.hu/oktatas/

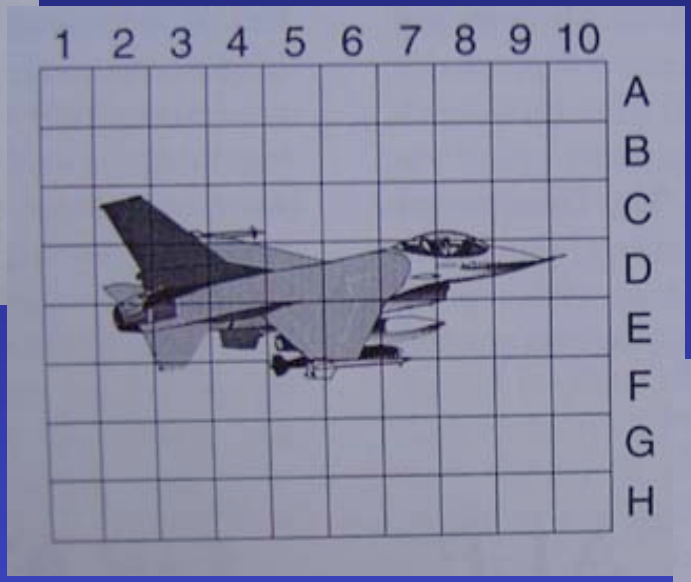
gabor@dentesthic.hu

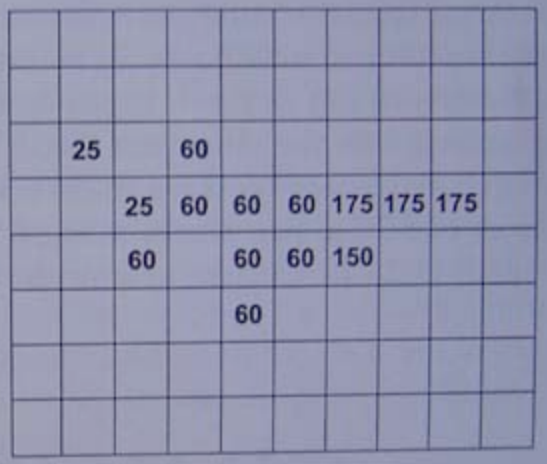
Indirect digital imaging
(Digitization)



analog- digital conversion







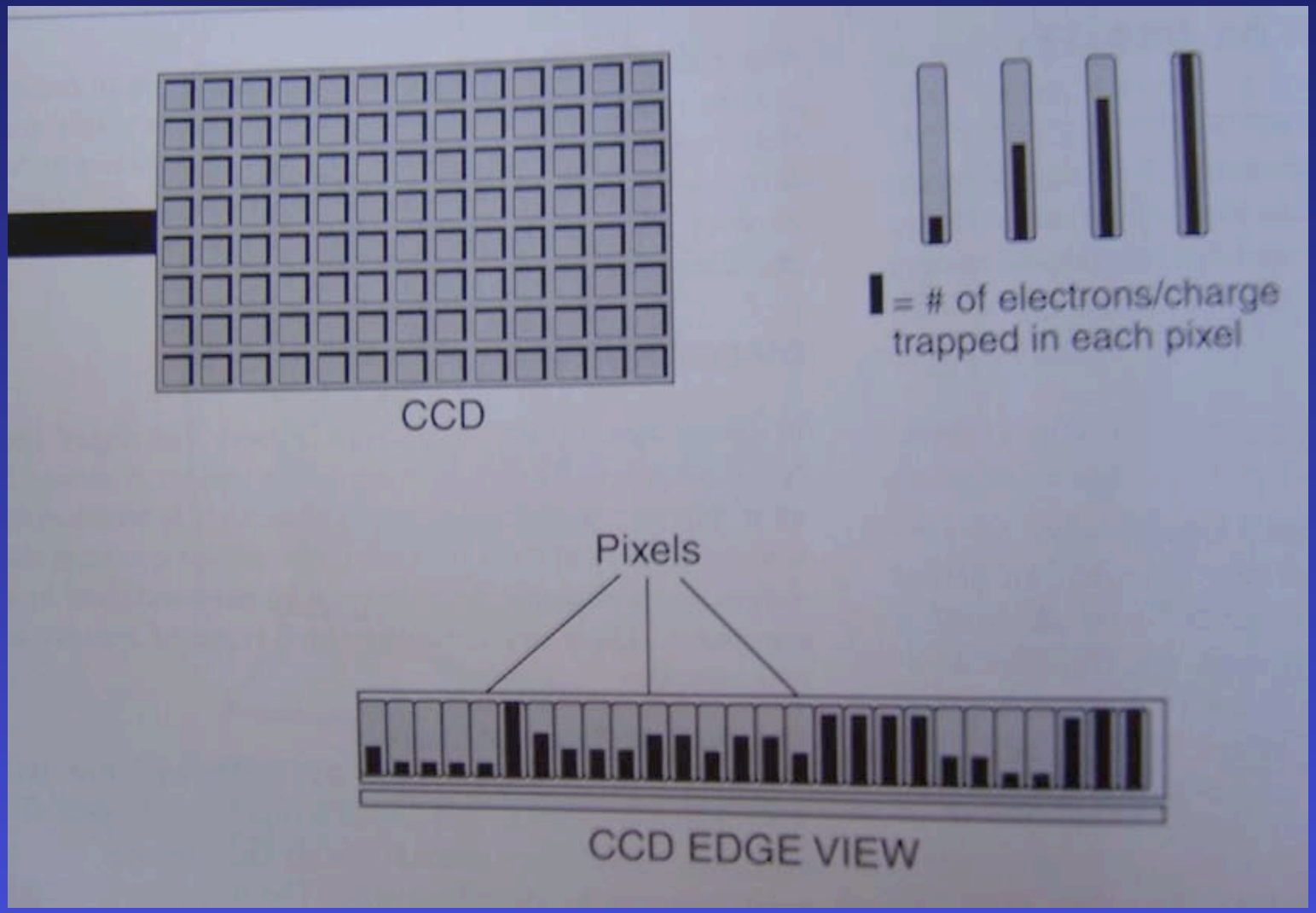
Direct digital imaging

CCD/CMOS

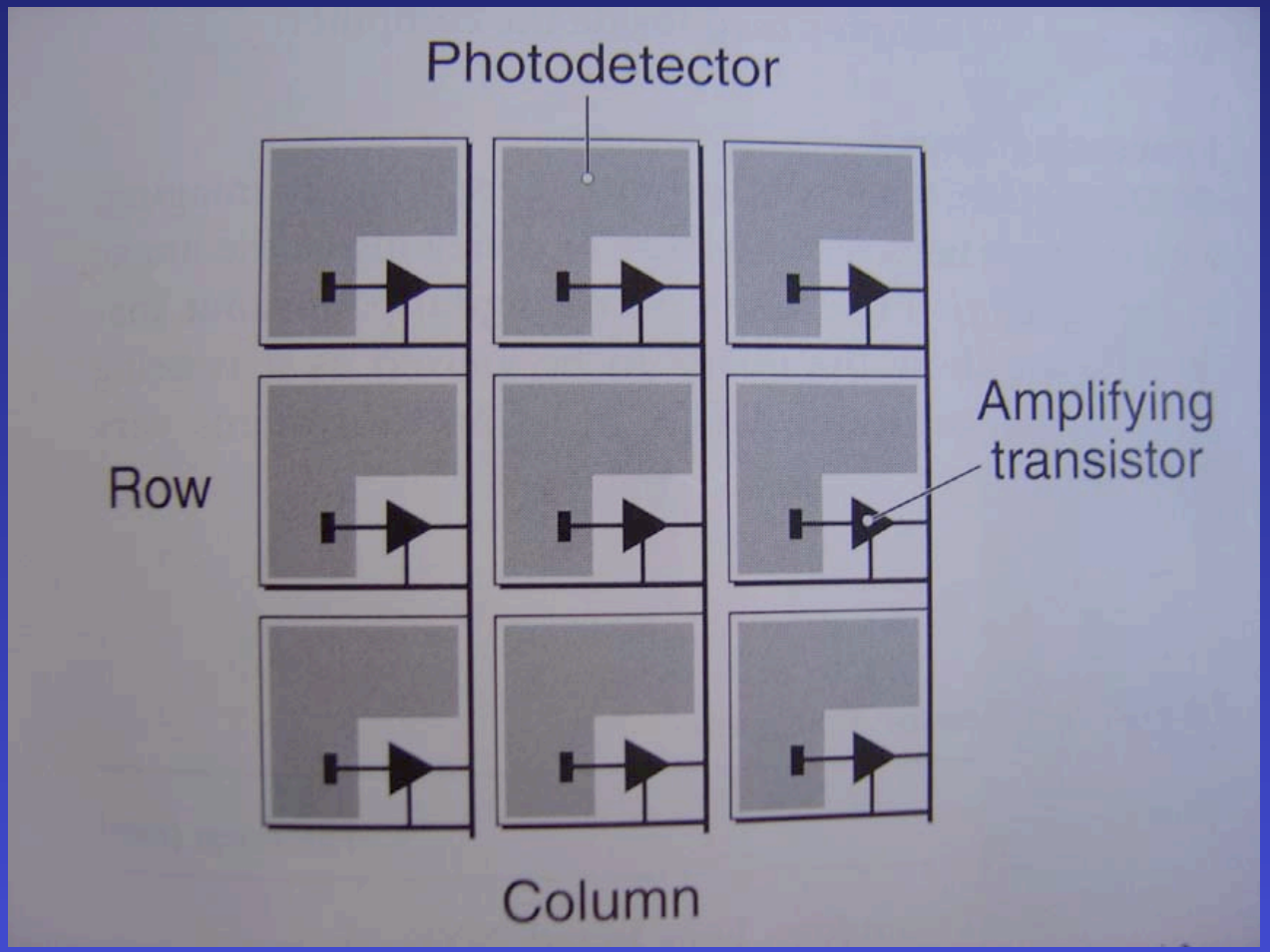
PSP

CCD
CMOS/APS

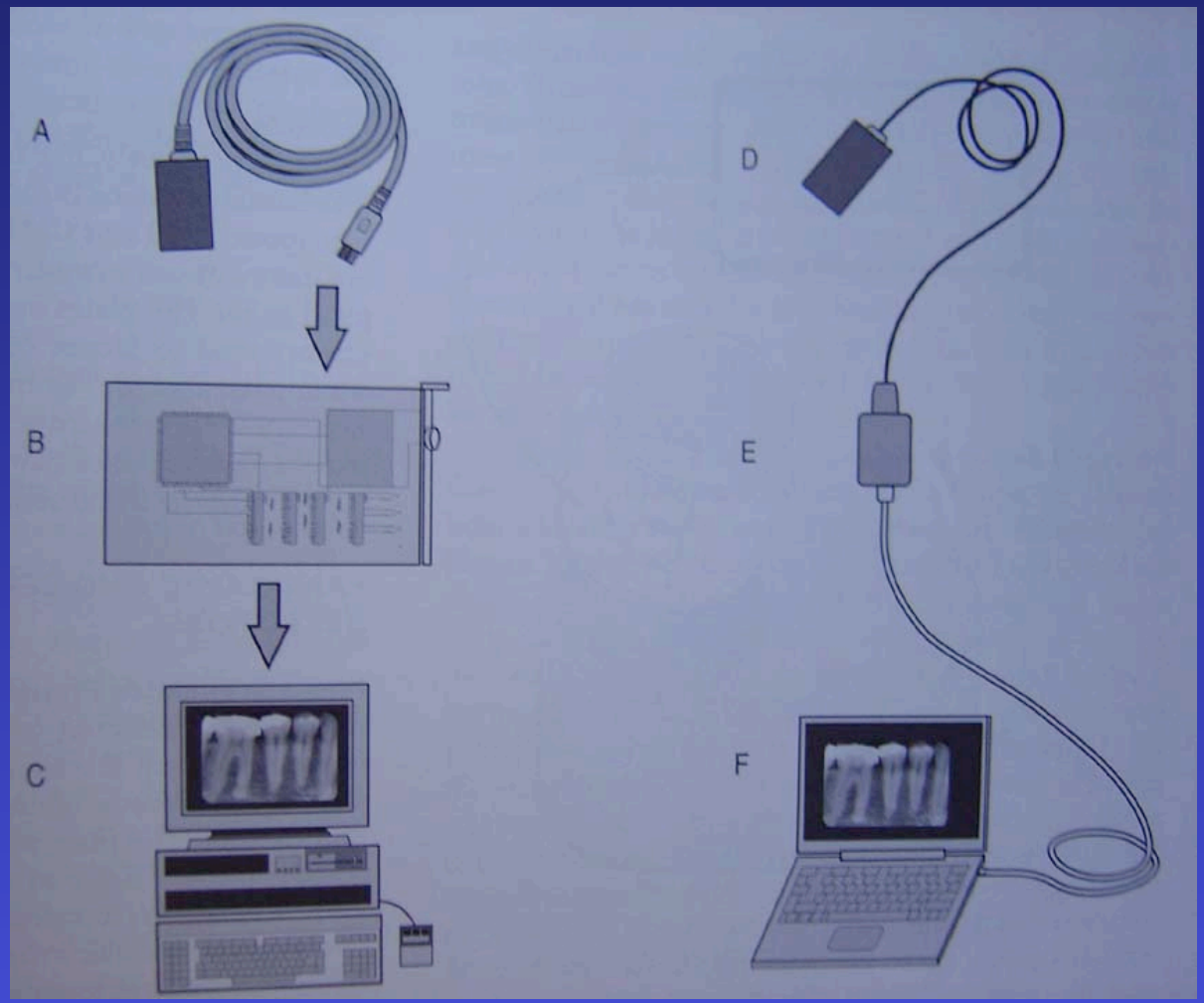
CCD sensor


= # of electrons/charge trapped in each pixel
CCD
Pixels
CCD EDGE VIEW

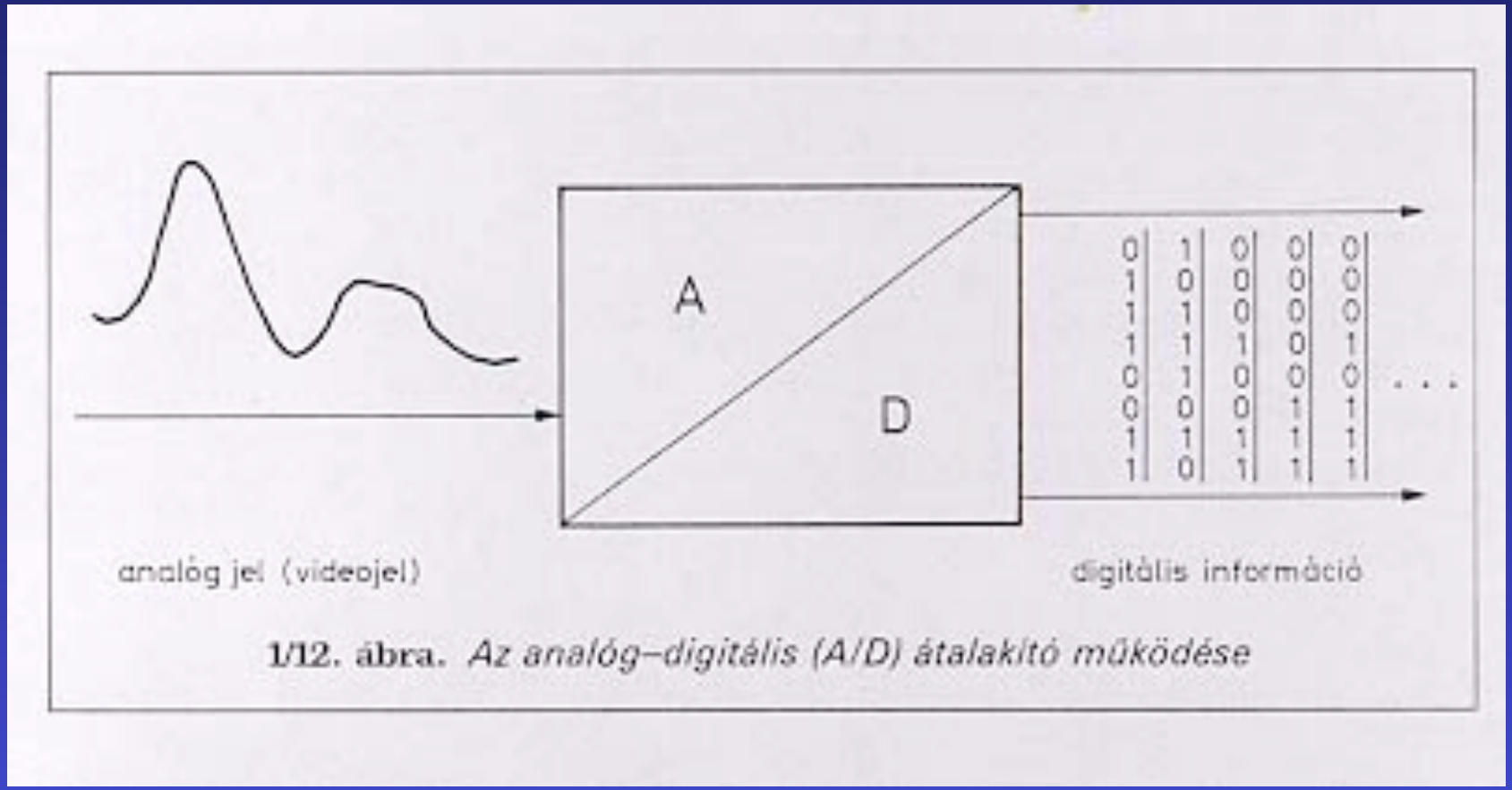
CMOS/APS



CCD,CMOS/APS



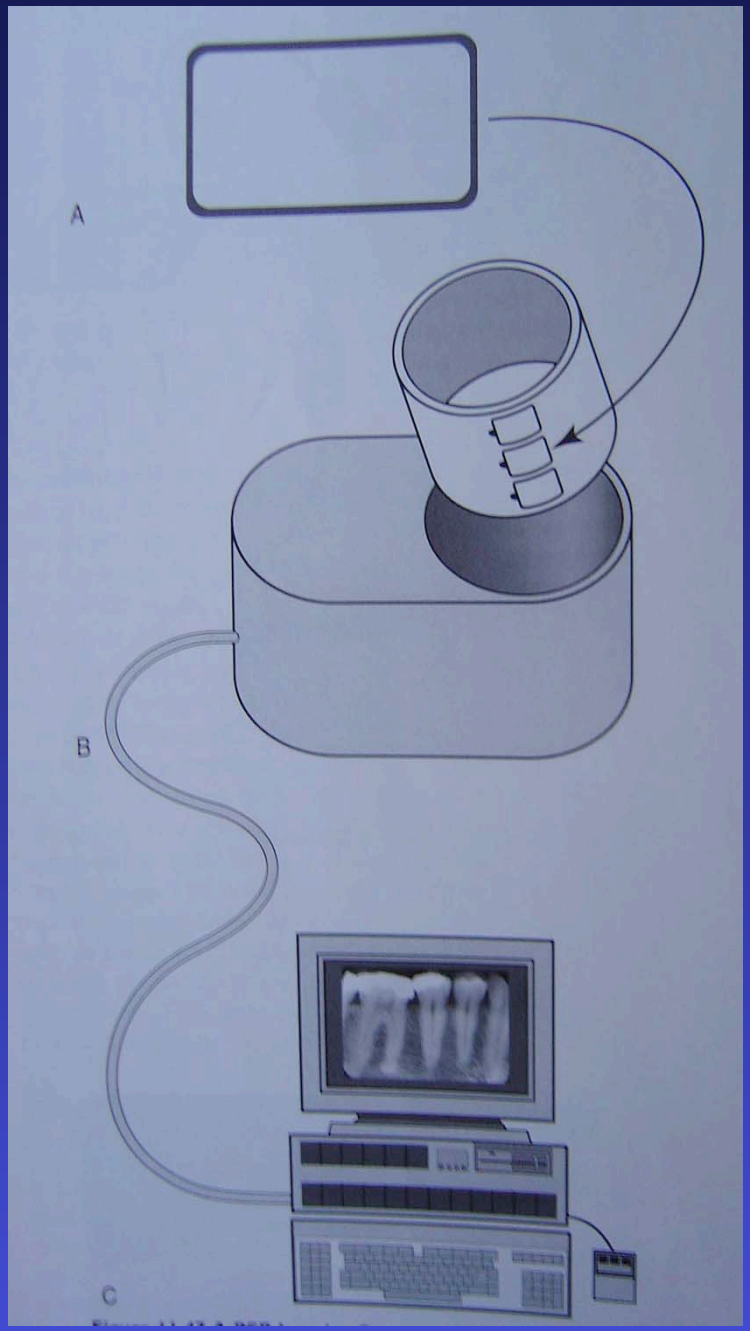
Analóg-digitális átalakítás

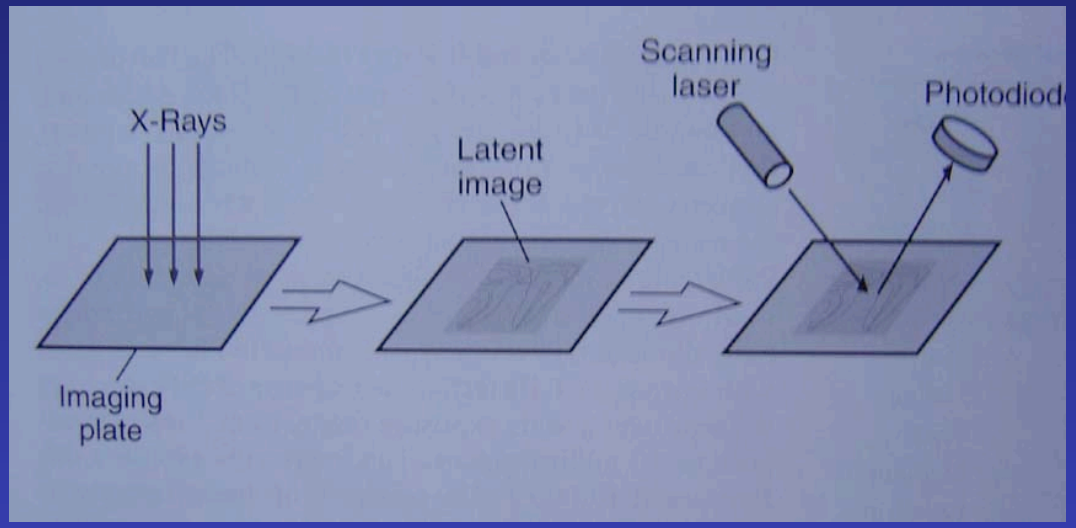


1/12. ábra. *Az analóg–digitális (A/D) átalakító működése*

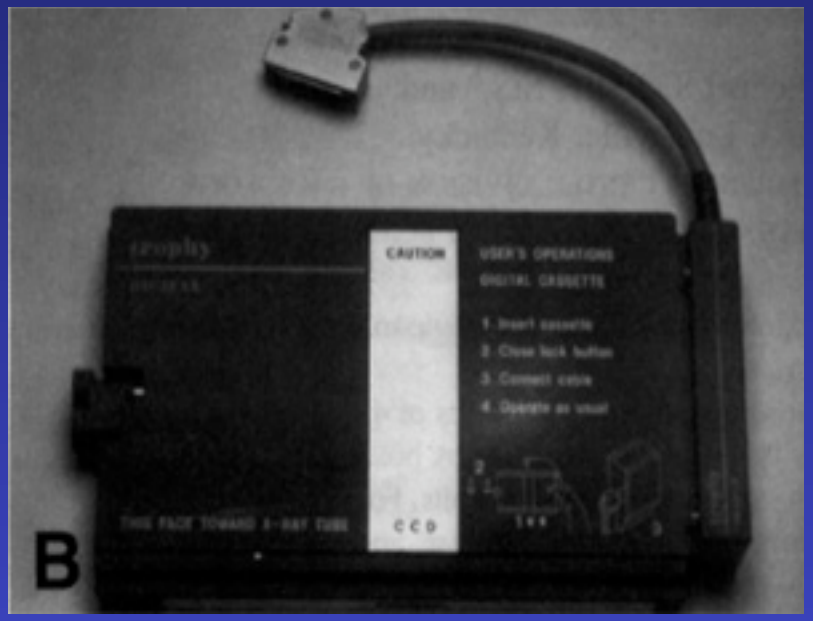
Phosphor Storage Plates (PSP)

PSP


A
B
C


X-Rays
Latent image
Scanning laser
Photodiod
Imaging plate

Panoramic systems



CCD

PSP

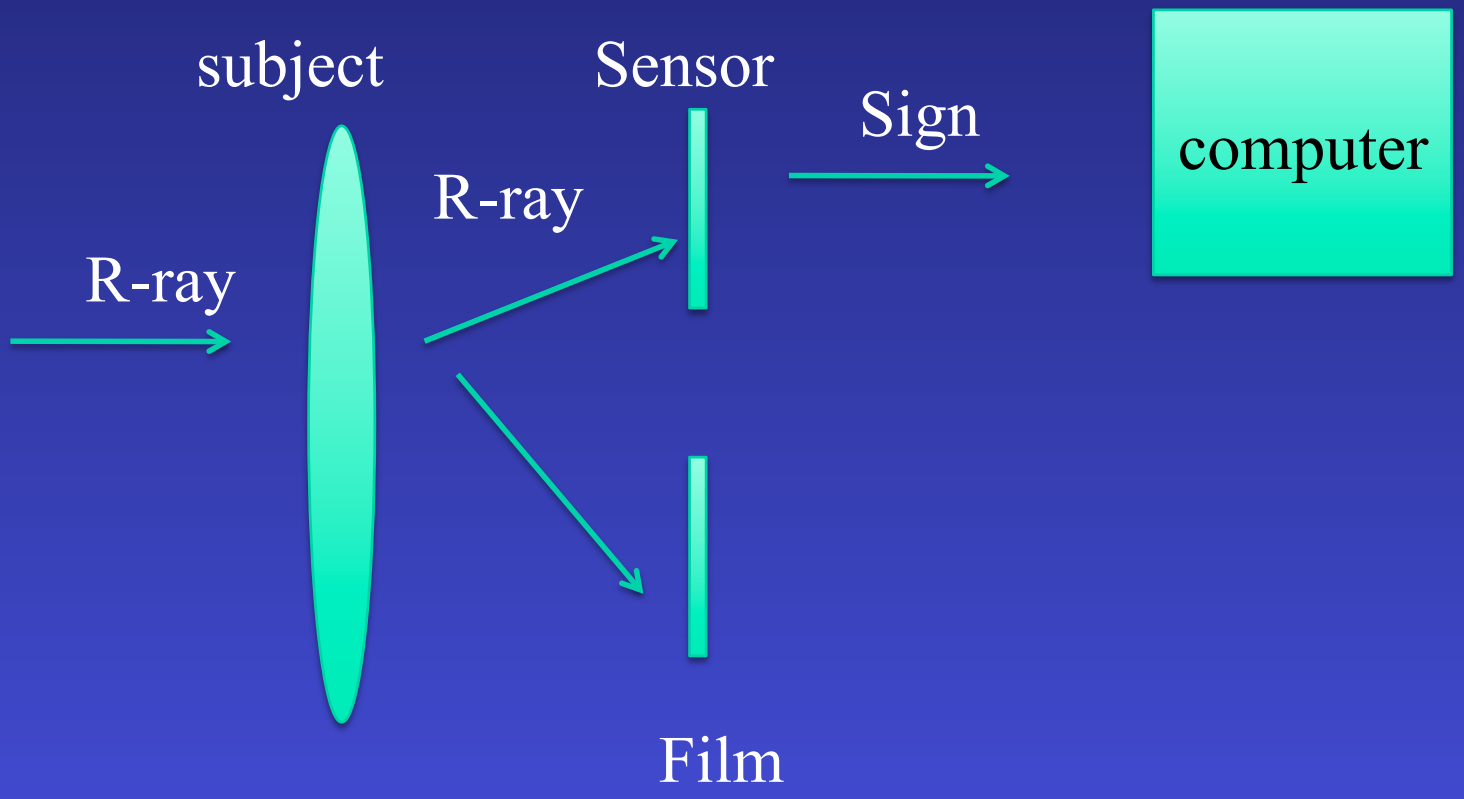
Product Name	Company	Type	Note
CDR	Schick	CCD	-
CDR Wireless	Schick	CCD	-
Combix Xi	Orex	PSP	Combined: Intraoral, Panorama and Ceph
CygnusRay MPS	Changed name to: MPS Digital X-ray Sensor System	CCD	-
DenOptix	Gendex	PSP	Can be combined with panorama
DenOptix Ceph	Gendex	PSP	Combined intraoral, panorama and ceph
DEXIS	ProVision Dental Systems, Inc.	CCD	-
Digora fmx	Soredex	PSP	-
Digora Optime	Soredex	PSP	-
Dixi® 2	Planmeca Group	CCD	-
Dixsy	Villa Sistemi Medicali	CCD	-
Dr. Suni Plus	Suni Medical Imaging Inc.	CCD	-
EVA	Dent-x	CCD	-
F1 iOX megapixel X-ray Sensor	Fimet	CCD	-
Flash Dent	-	CCD	the new and updated version is Dixsy

http://www.odont.au.dk/rad/Digitalx.htm#producer

MPDx	Remedent N.V.	CCD	-
MPS Digital X-ray Sensor System	Progeny Dental	CCD	-
Multiscan	No longer sold	PSP	Combined: Intraoral, Panorama and Ceph
NI-DX	Dentsply New Image	CCD	activity shut down
Panasonic	-	CCD	Sold as CygnusRay by Cygnus Technologies
Paxorama Xi	Orex	PSP	Combined: Intraoral, Panorama and Ceph
Sens-A-Ray	Dent-x	CCD	No longer sold, replaced by EVA
SIDEXIS	Sirona	CCD	-
SIGMA	Instrumentarium imaging	CCD	-
RVG	Trophy	CCD	-
VistaRay Sensor	Dürr Dental	CCD	-
VistaScan	Dürr Dental	PSP	Combined intraoral, panorama and ceph
VistaScan Intra	Dürr Dental	PSP	-
VisualiX HDI	Gendex	CCD	-

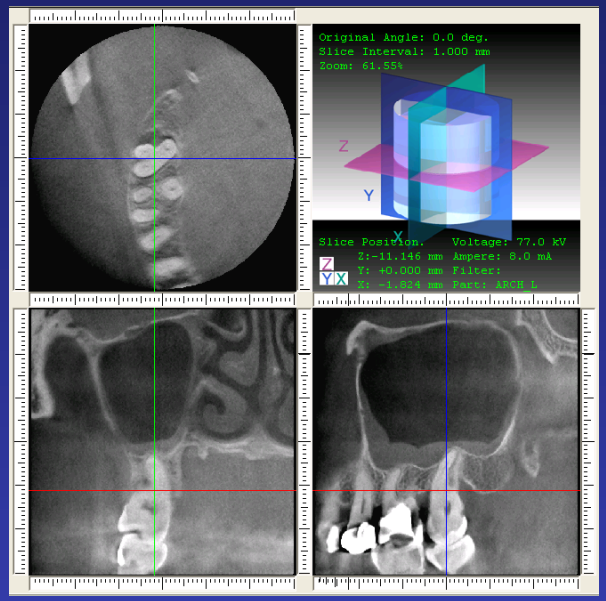
http://www.odont.au.dk/rad/Digitalx.htm#producer

Diagnostic imaging



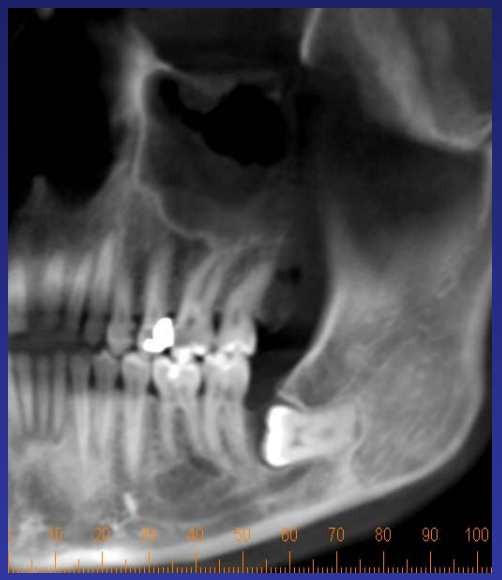
Cone Beam CT (CBCT)

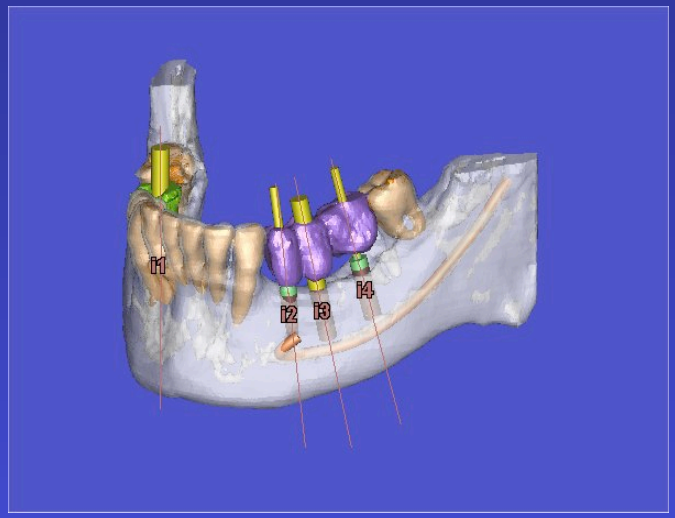
axial



frontal sagittall

DRR (digitally reconstructed radiogram)





Visualization („3D”)

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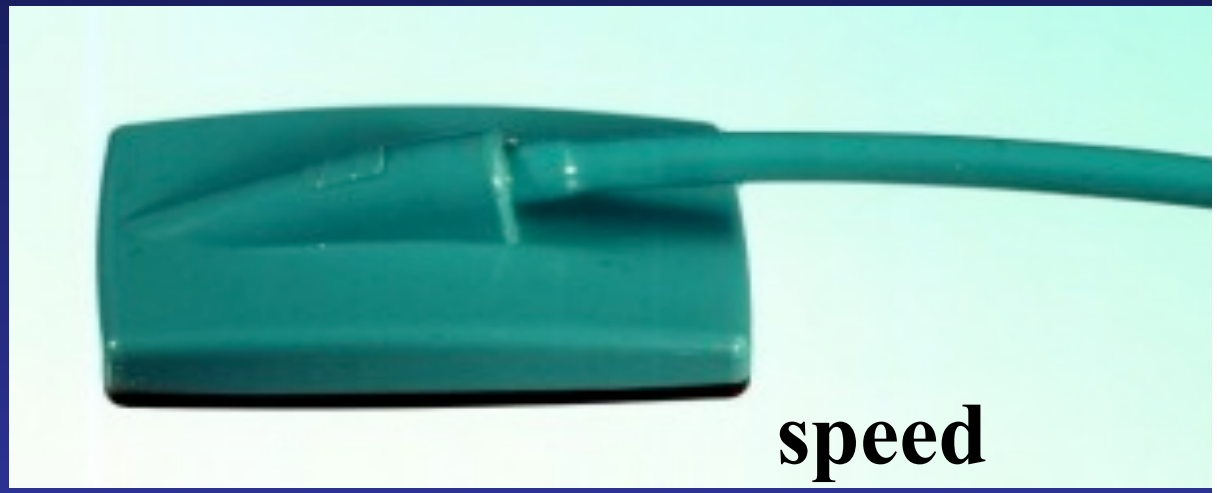
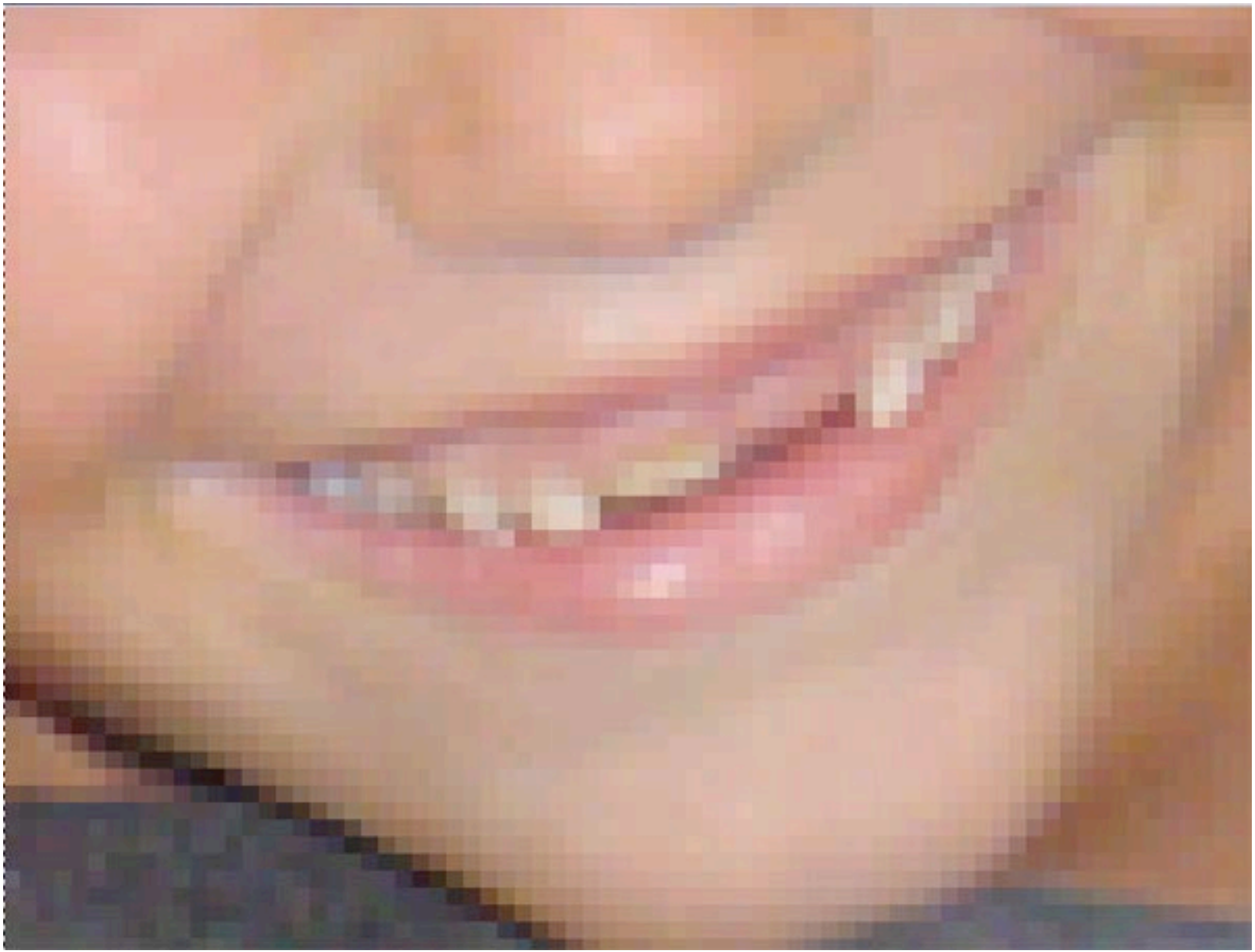


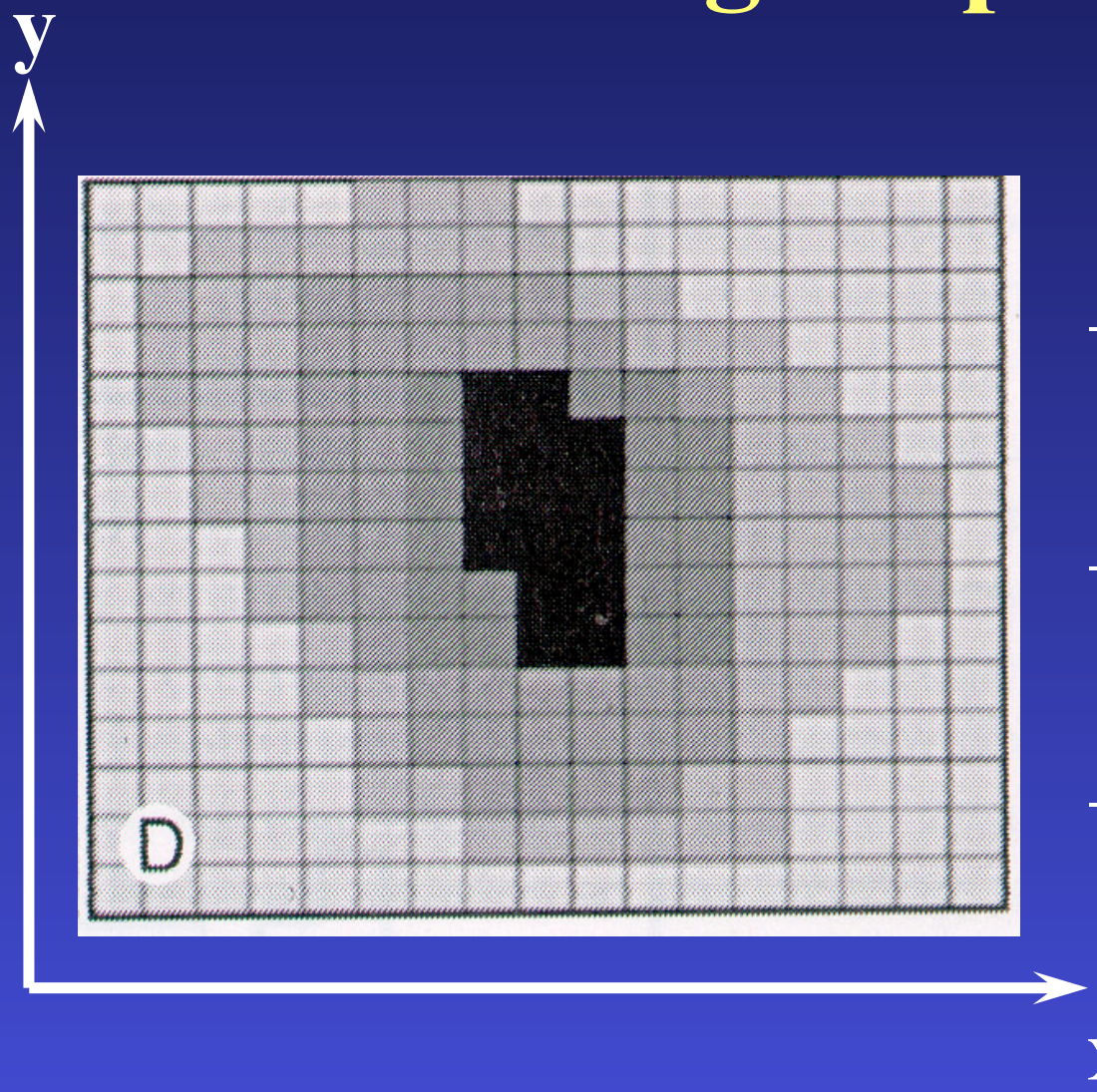
speed

?

Size of sensor



Digital picture



– **pixel** (picture element)
  (x, y, depth)
– **file format**
  (TIFF, JPEG, BMP...)
– **dinamic**

Resolution (lp/mm)

Film	12-20
CCD, CMOS	8-22
PSP	6-8
Human eye	8-10

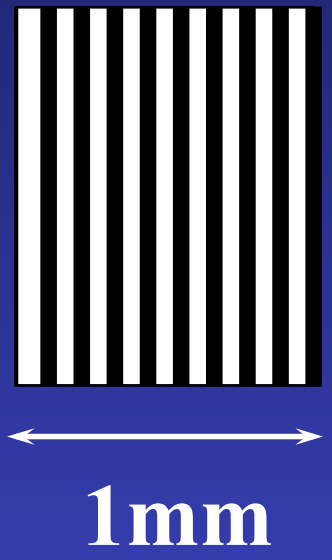
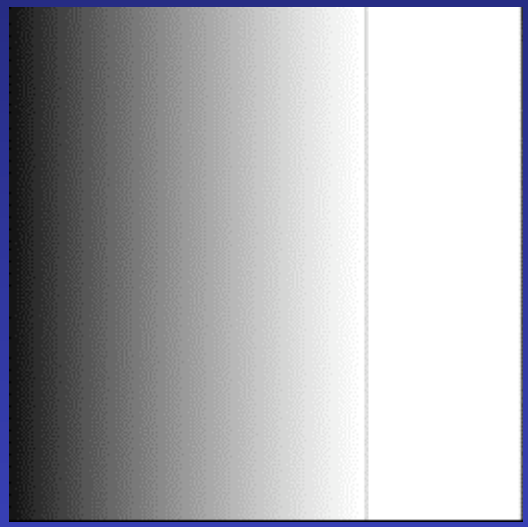


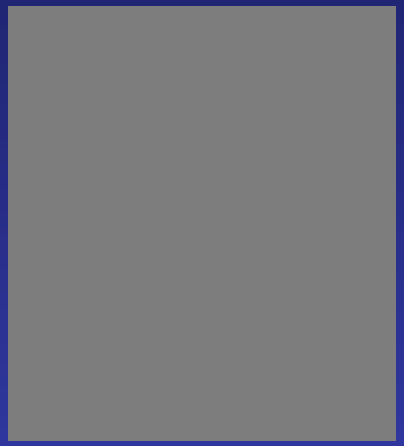
Image depth

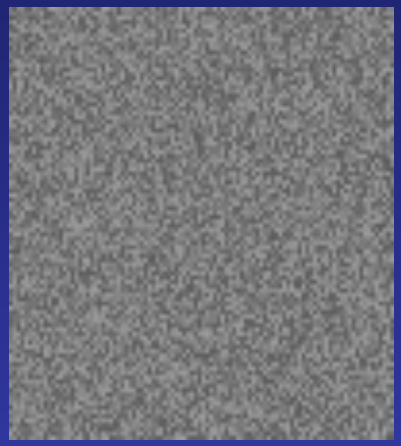
film	cont.
Digital picture	256
Human eye	64



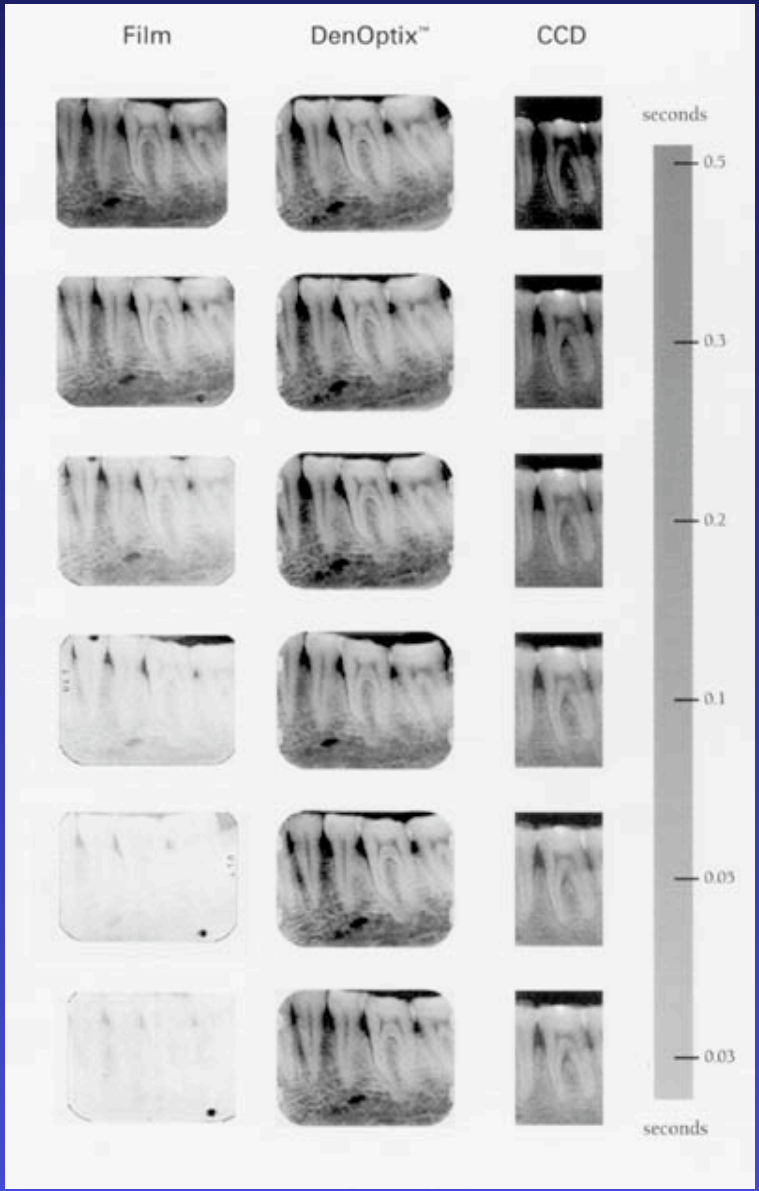
Noise

- min 5:1
- CCD 10-20
- PSP 10-40
- film 30





Dinamic range



T_{exp_min} / T_{exp_max}

Film based imaging

Film: acquire
display
store

Picture: static

Digital imaging

Sensor: acquire

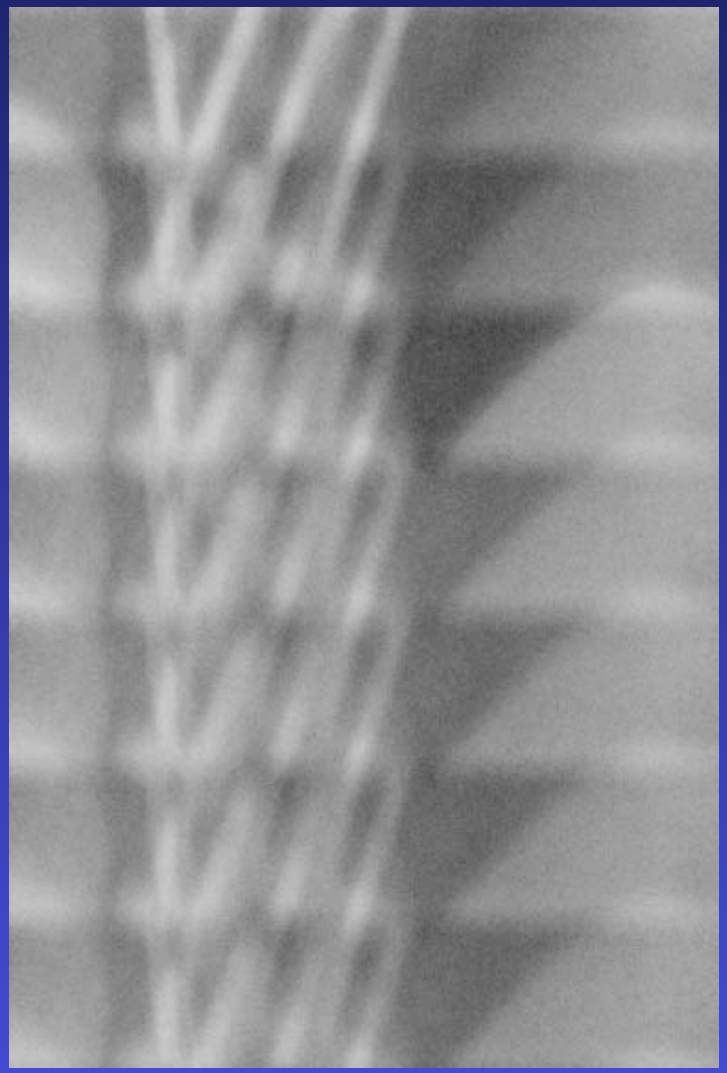
PC: display
store
postprocessing

Picture: dinamic

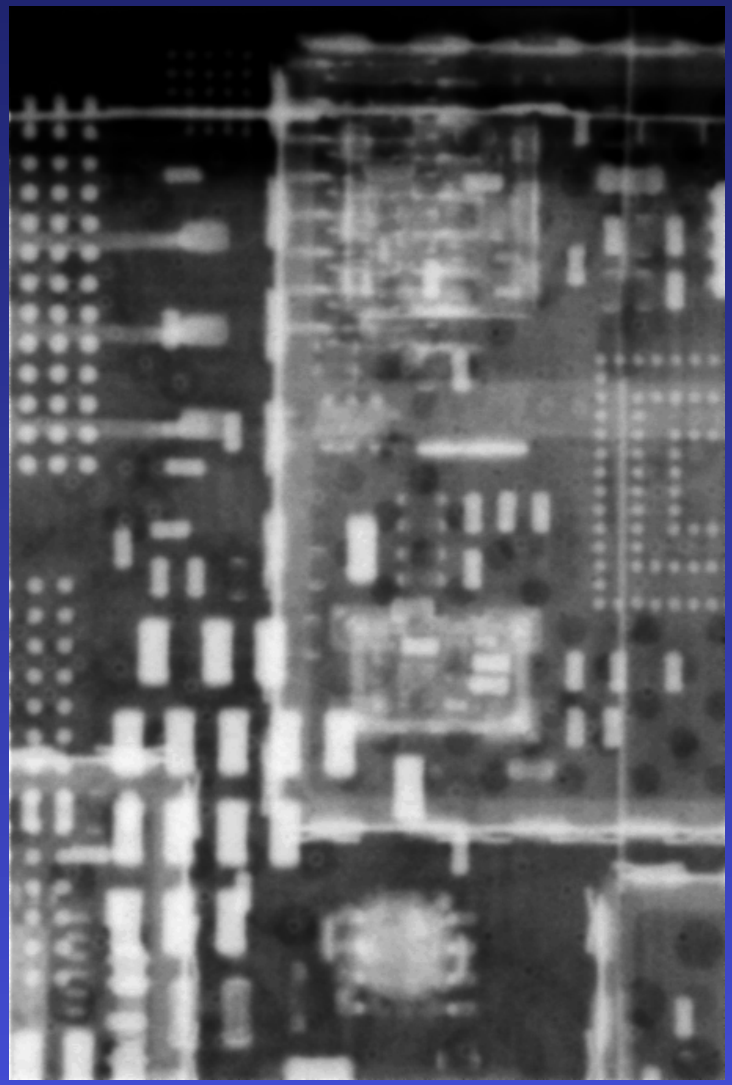
Problems

- Initial high cost
- Computers and us
- Lack of knowledge
- Lack of integration

Problems (CCD)



CCD sensor



Problems (PSP)

Advantages

- Enviroment friendly
- Speed
- Less dose
- Quantitative mesure
- Postprocessing
- Reconstruction
- Communication

Speed

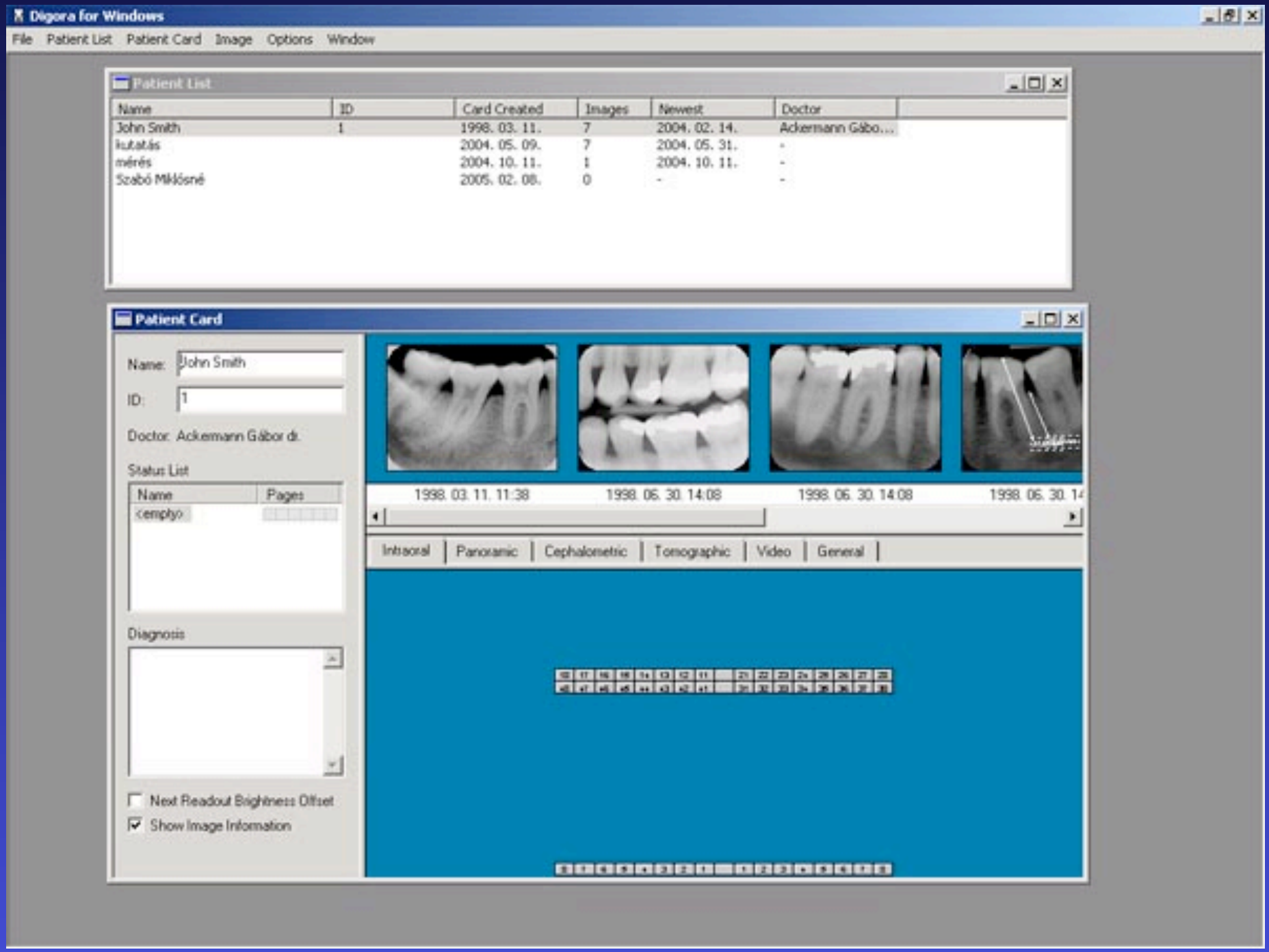
Film	6-8 min
CCD	instant
PSP	1.5-2.5 min (5.5 min)

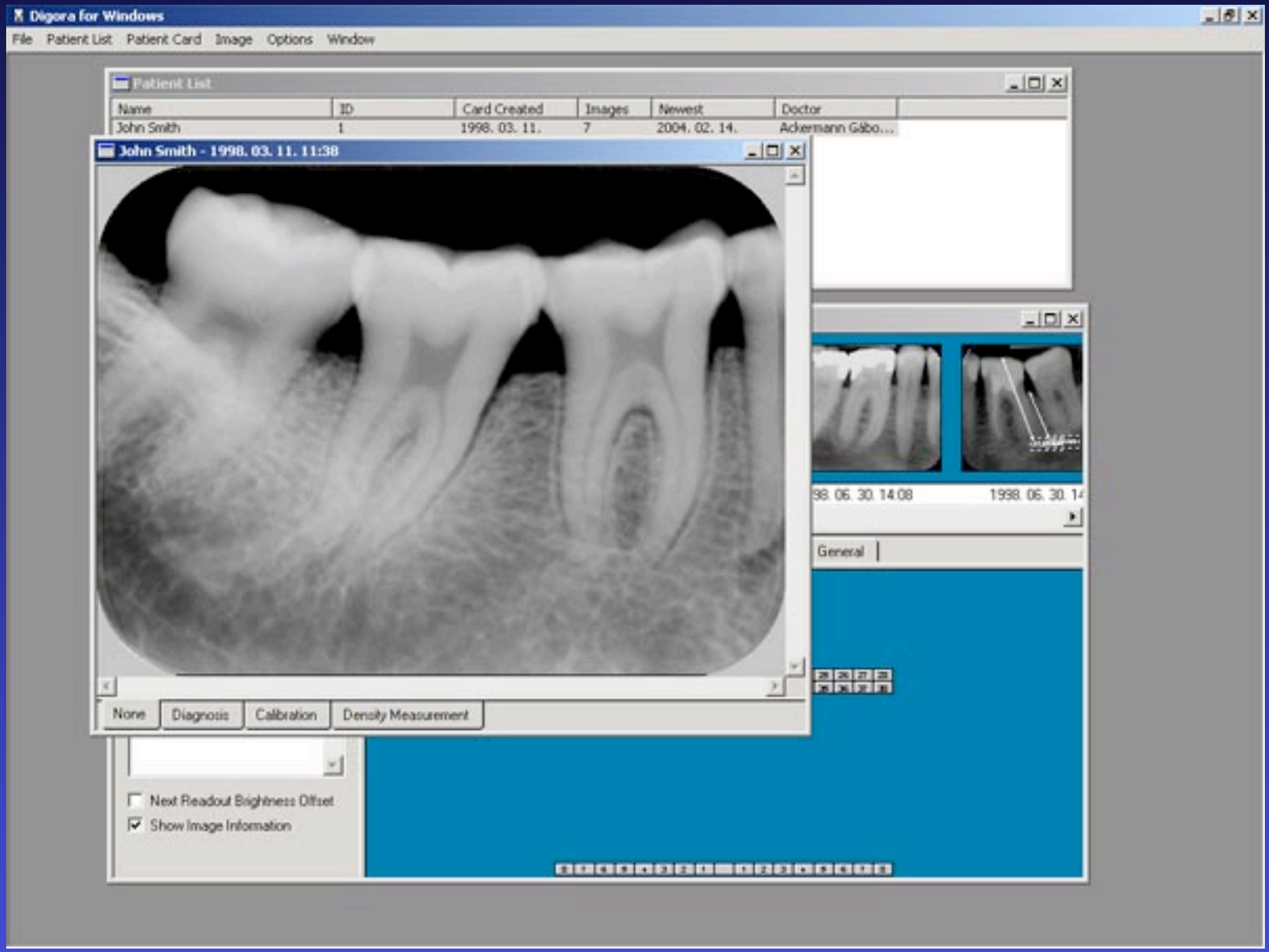
Dose reduction

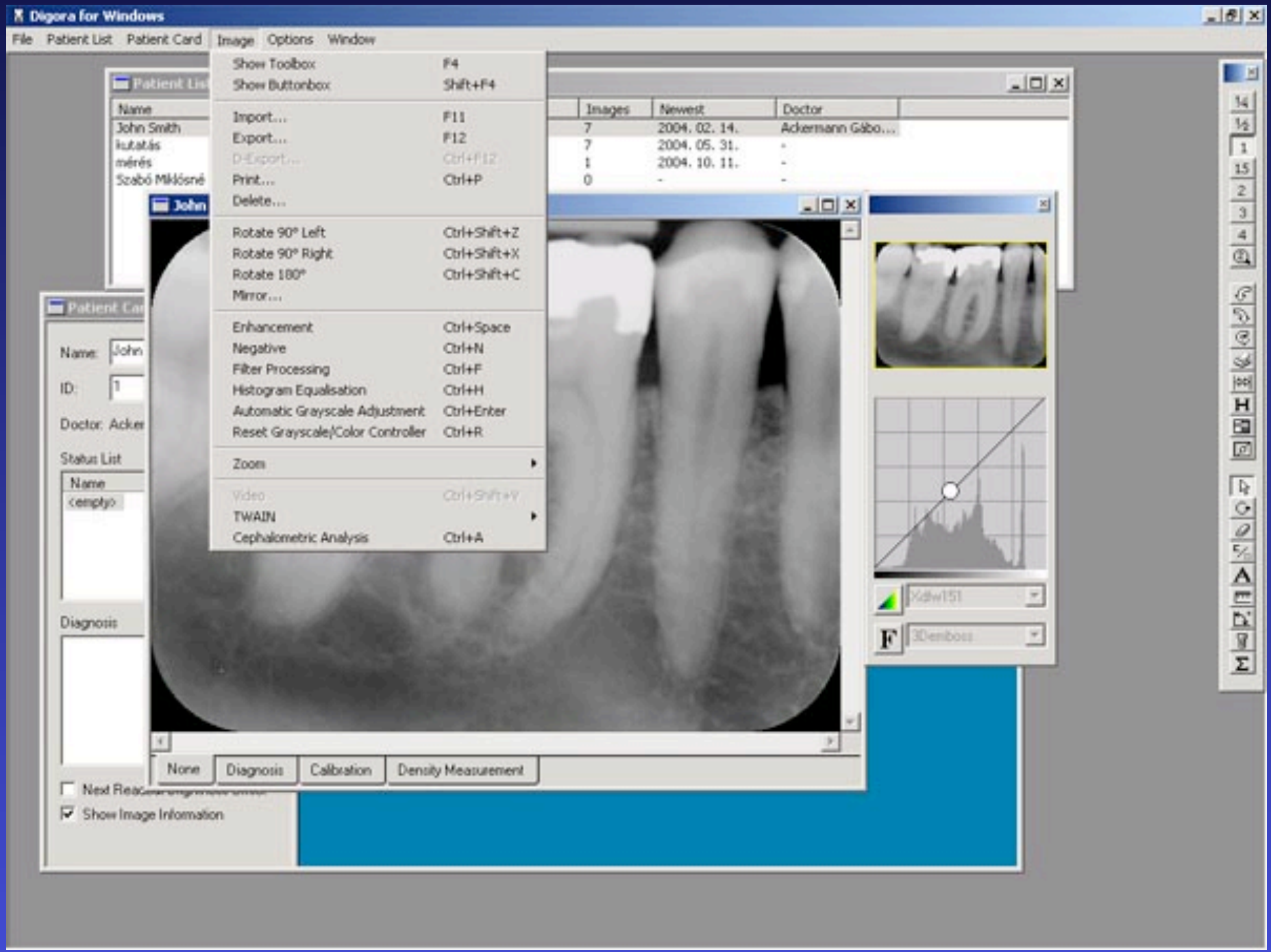
- D (80-90%), E (60%), F film (40%)
- Faster imaging – more picture
- sensor size
  - film 1200 mm^2
  - CCD, CMOS 600-950 mm^2
  - PSP 1200 mm^2

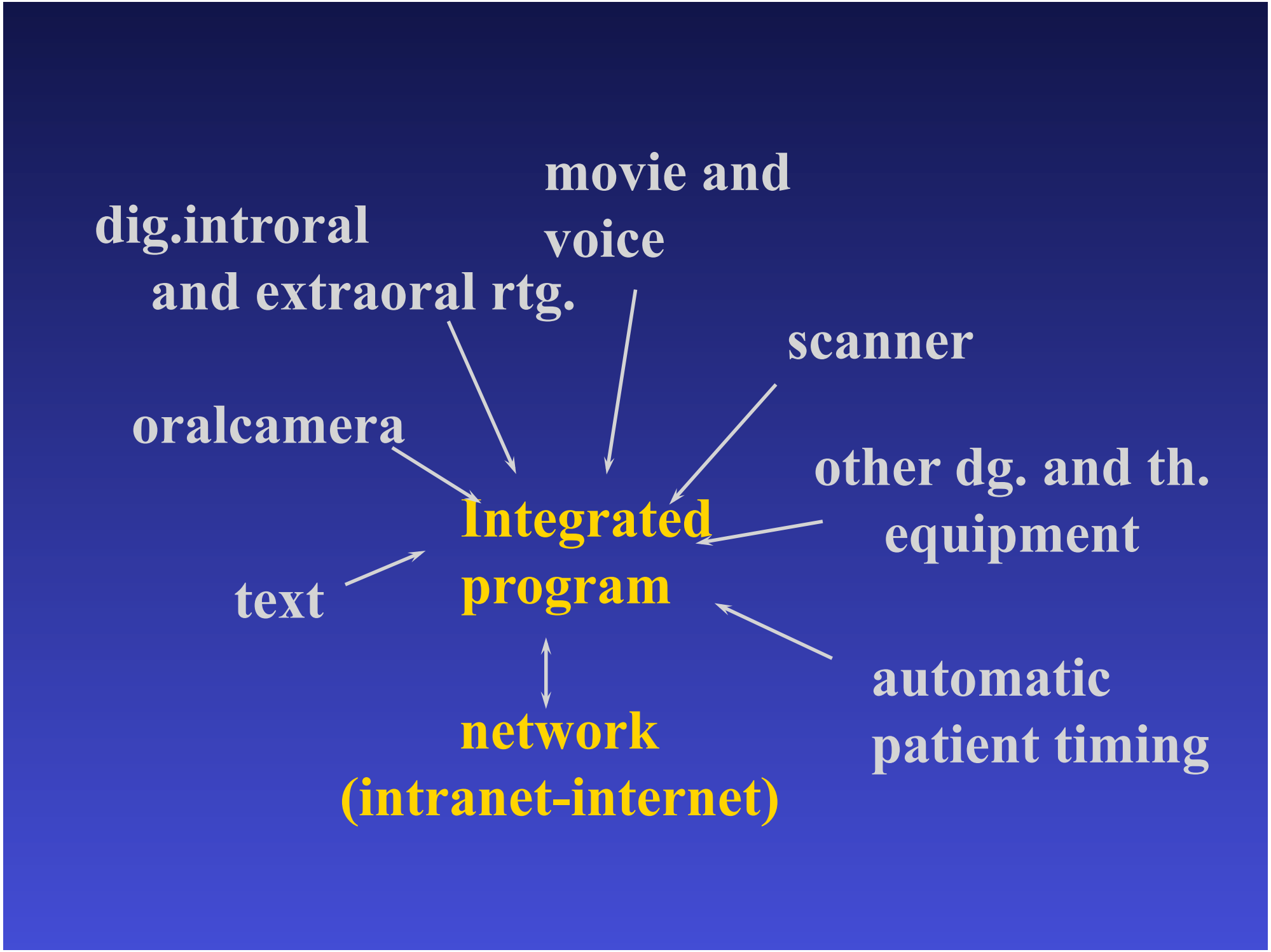
Imaging program

- Patient chart
- Image handeling
  - export/import, open, delete, print…
- Image analysis
    - hisztogram, density-,distance-, angle mesurement…
- Image postprocessing (subjective/objective)
    - rotation, zooming
    - density/contrast, pozitive, edge enhancement, color coding


Digora for Windows
File Patient List Patient Card Image Options Window
Patient List
Name ID Card Created Images Newest Doctor
John Smith 1 1998. 03. 11. 7 2004. 02. 14. Ackermann Gábo...
kutatás 2004. 05. 09. 7 2004. 05. 31. -
mérés 2004. 10. 11. 1 2004. 10. 11. -
Szabó Miklósné 2005. 02. 08. 0 - -
Patient Card
Name: John Smith
ID: 1
Doctor: Ackermann Gábor dr.
Status List
Name Pages
<empty>
Diagnosis
Next Readout Brightness Offset
Show Image Information
1998. 03. 11. 11:38
1998. 06. 30. 14:08
1998. 06. 30. 14:08
Intraoral Panoramic Cephalometric Tomographic Video General


Digora for Windows
File Patient List Patient Card Image Options Window
Patient List
Name ID Card Created Images Newest Doctor
John Smith 1 1998. 03. 11. 7 2004. 02. 14. Ackermann Gábo...
John Smith - 1998. 03. 11. 11:38
None Diagnosis Calibration Density Measurement
Next Readout Brightness Offset
Show Image Information
98. 06. 30. 14:08
1998. 06. 30. 14
General


Digora for Windows
File
Patient List
Patient Card
Image
Options
Window
Show Toolbox F4
Show Buttonbox Shift+F4
Import... F11
Export... F12
D-Export... Ctrl+F12
Print... Ctrl+P
Delete...
Rotate 90° Left Ctrl+Shift+Z
Rotate 90° Right Ctrl+Shift+X
Rotate 180° Ctrl+Shift+C
Mirror...
Enhancement Ctrl+Space
Negative Ctrl+N
Filter Processing Ctrl+F
Histogram Equalisation Ctrl+H
Automatic Grayscale Adjustment Ctrl+Enter
Reset Grayscale/Color Controller Ctrl+R
Zoom
Video Ctrl+Shift+V
TWAIN
Cephalometric Analysis Ctrl+A
Patient List
Name
John Smith
kutatás
mérés
Szabó Miklósné
Images
Newest
Doctor
7 2004. 02. 14. Ackermann Gábo...
7 2004. 05. 31. -
1 2004. 10. 11. -
0 - -
Patient Card
Name: John
ID: 1
Doctor: Acker
Status List
Name
<empty>
Diagnosis
Next Rea
Show Image Information
John
None
Diagnosis
Calibration
Density Measurement
Xdiw151
3Demboss


movie and
voice
dig.introral
and extraoral rtg.
scanner
oralcamera
other dg. and th.
equipment
Integrated
program
text
automatic
patient timing
network
(intranet-internet)

PDS 6.3 Net Integrált Fogászati Információs Rendszer Regisztrálva: Újezüst BT. Fejleszti: Dr. Csala Péter (C) Kreatech 1995-2005

Kezelés alatt állók:

19	6	Ackermann Gábor	2

Orvos: Dr. Ackermann Gábor 2

Beteg: **Ackermann Gábor**

Státusz Admin ÓRA Nr: 2330

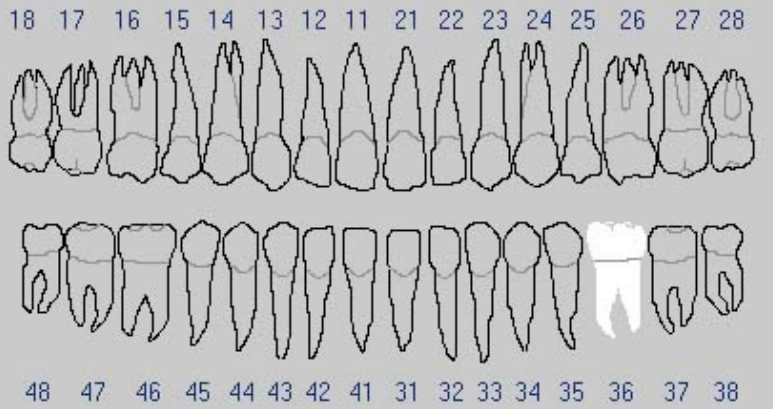
Kezelendő és kezelt betegek Törlés

Adatok | Történet | Anamnézis | Kezelés | Előjegyzés | Laborlapok | Felvételek | Nyilvántartás

Státusz | Intraorális felvételek | Röntgen felvételek | RTG váró | Hagyományos RTG képek

Röntgenre váró betegek:

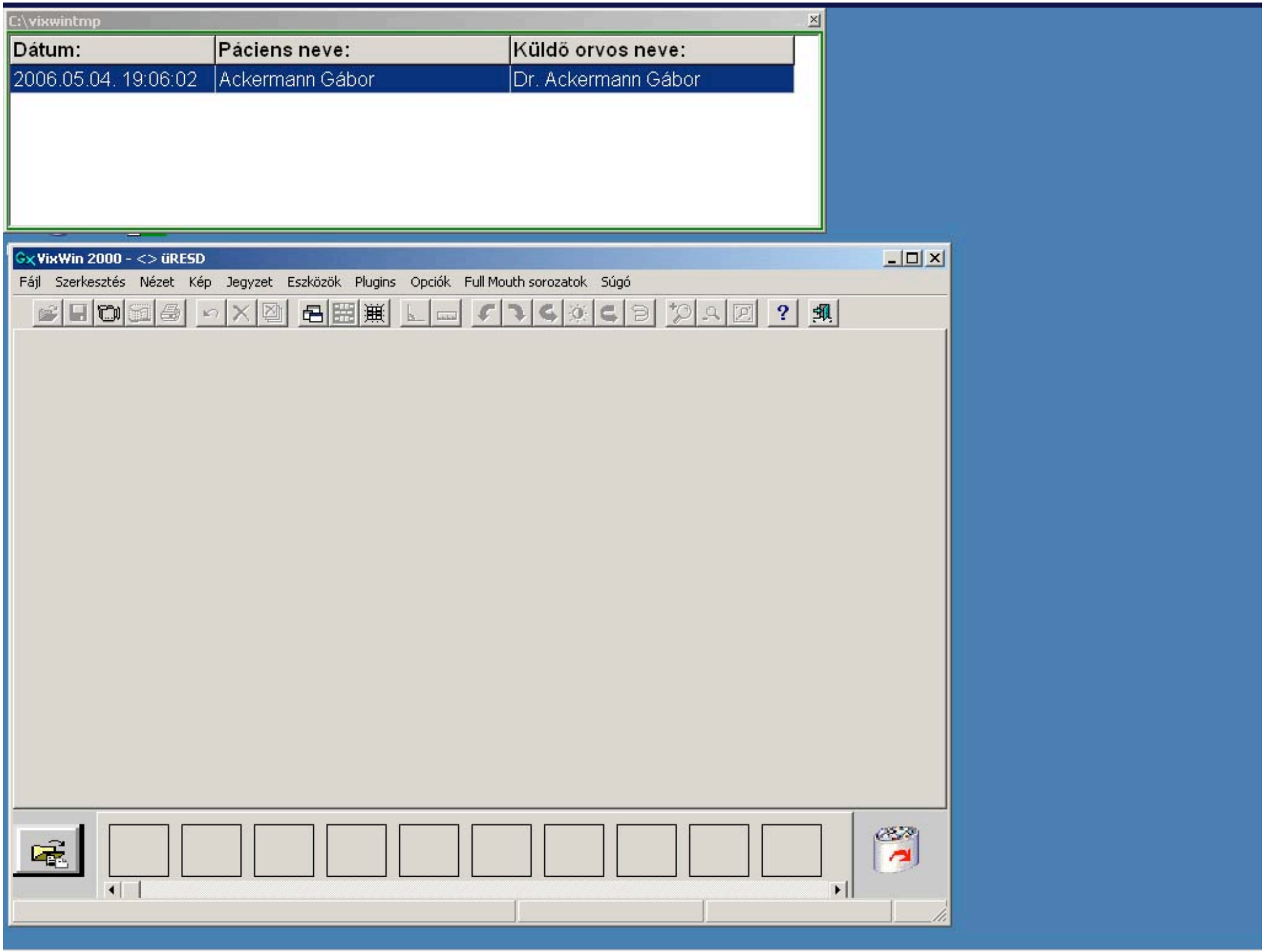
Jelölje ki a felvételre szánt fogakat!

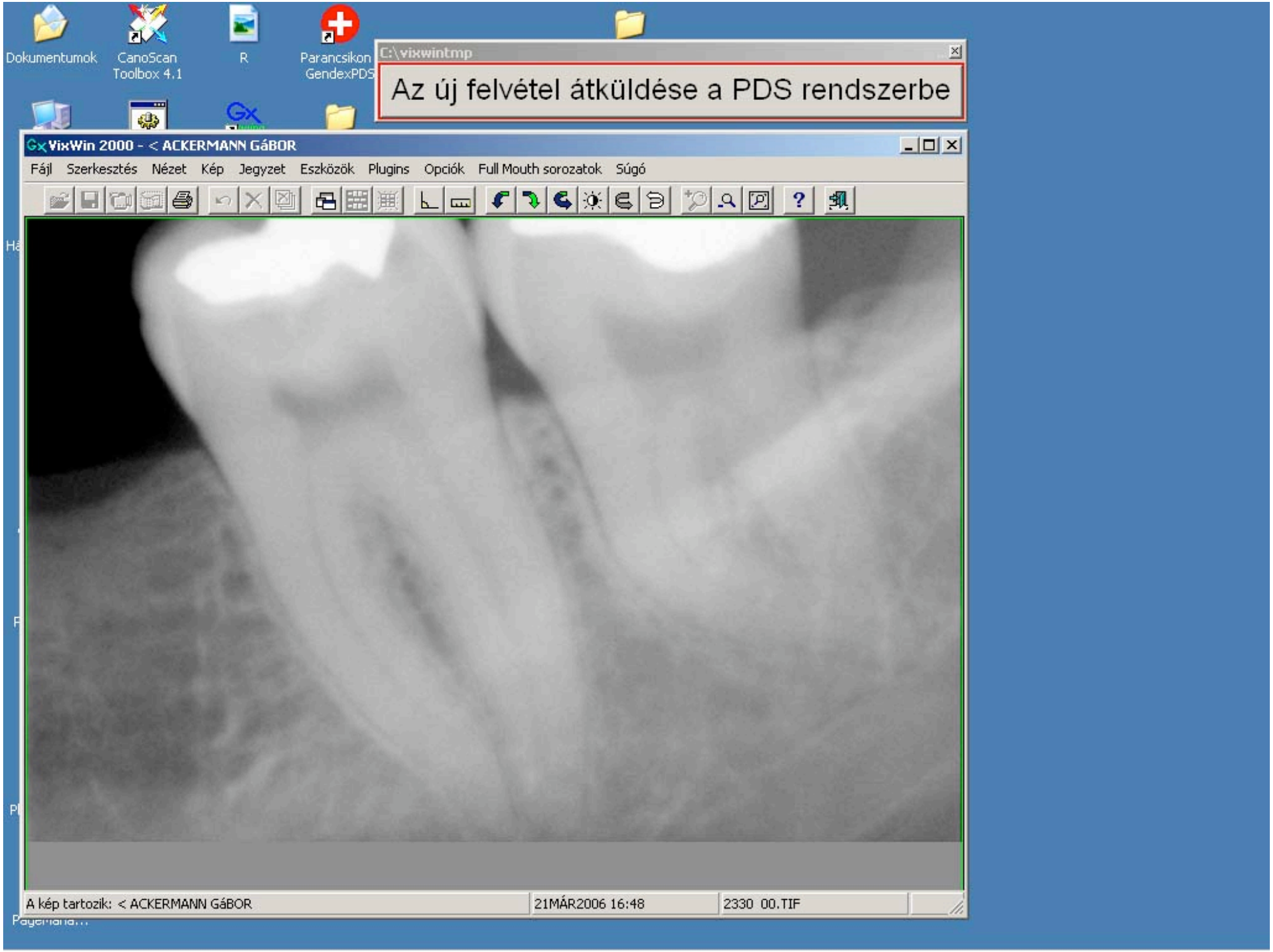


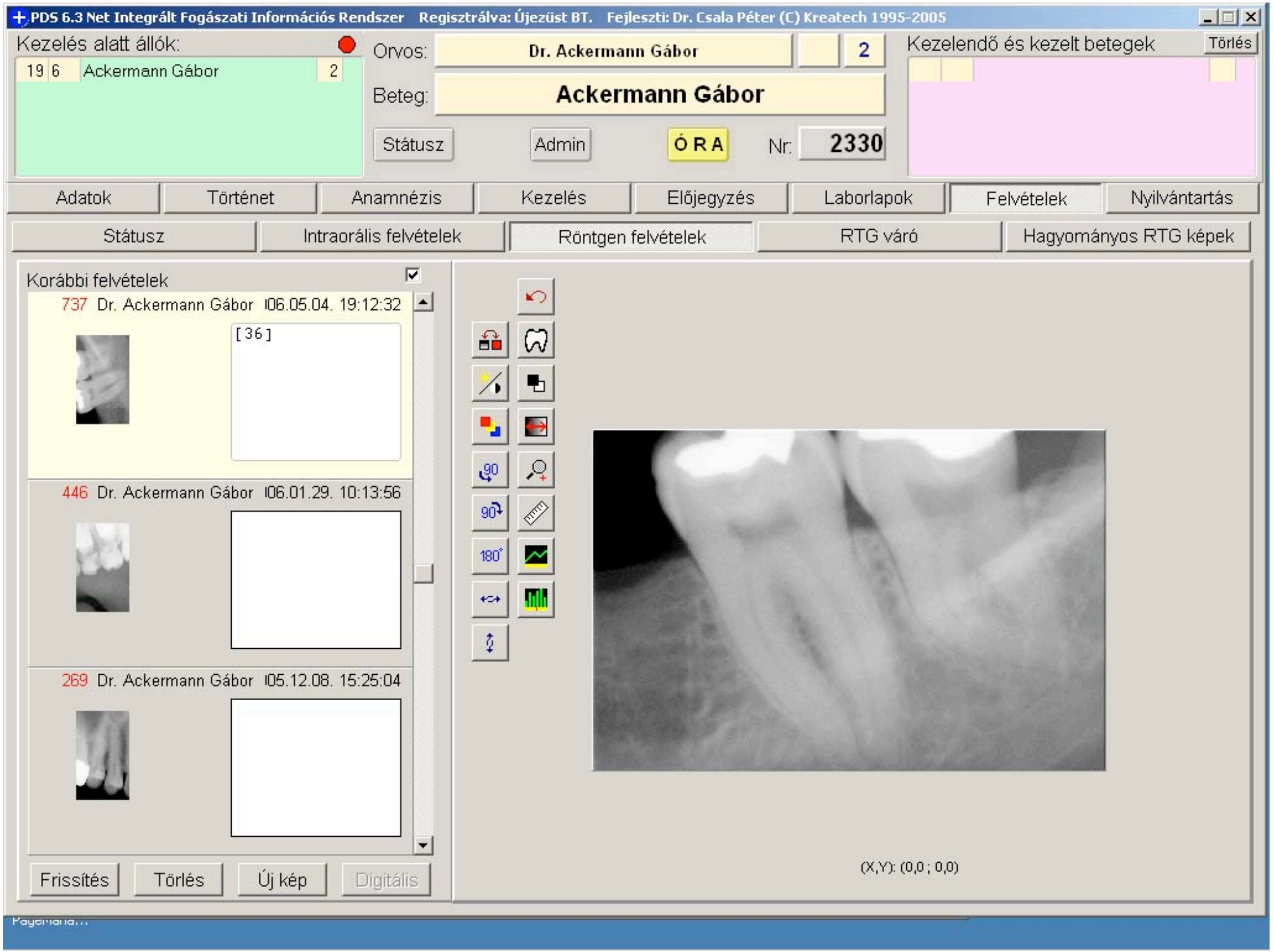
Mégsem Felvétel

Beteg törlése a RTG váróból Beteg felvétele a RTG-re

Start VixWin 2000 - <> üRESD Gendexpds doki2 HU 19:05


C:\vixwintmp
Dátum:
Páciens neve:
Küldő orvos neve:
2006.05.04. 19:06:02
Ackermann Gábor
Dr. Ackermann Gábor
VixWin 2000 - <> üRESD
Fájl
Szerkesztés
Nézet
Kép
Jegyzet
Eszközök
Plugins
Opciók
Full Mouth sorozatok
Súgó


Dokumentumok
CanoScan Toolbox 4.1
R
Parancsikon GendexPDS
C:\vixwintmp
Az új felvétel átküldése a PDS rendszerbe
VixWin 2000 - < ACKERMANN GáBOR
Fájl Szerkesztés Nézet Kép Jegyzet Eszközök Plugins Opciók Full Mouth sorozatok Súgó
A kép tartozik: < ACKERMANN GáBOR
21MÁR2006 16:48
2330 00.TIF


PDS 6.3 Net Integrált Fogászati Információs Rendszer Regisztrálva: Újezüst BT. Fejleszti: Dr. Csala Péter (C) Kreatech 1995-2005
Kezelés alatt állók:
19 6 Ackermann Gábor 2
Orvos: Dr. Ackermann Gábor 2
Beteg: Ackermann Gábor
Státusz
Admin
ÓRA
Nr: 2330
Kezelendő és kezelt betegek
Törlés
Adatok
Történet
Anamnézis
Kezelés
Előjegyzés
Laborlapok
Felvételek
Nyilvántartás
Státusz
Intraorális felvételek
Röntgen felvételek
RTG váró
Hagyományos RTG képek
Korábbi felvételek
737 Dr. Ackermann Gábor I06.05.04. 19:12:32
[36]
446 Dr. Ackermann Gábor I06.01.29. 10:13:56
269 Dr. Ackermann Gábor I05.12.08. 15:25:04
Frissítés
Törlés
Új kép
Digitális
(X,Y): (0,0 ; 0,0)

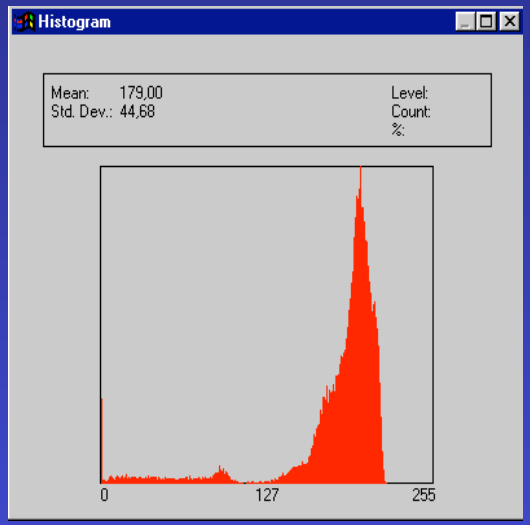
Postprocessing
better visibility

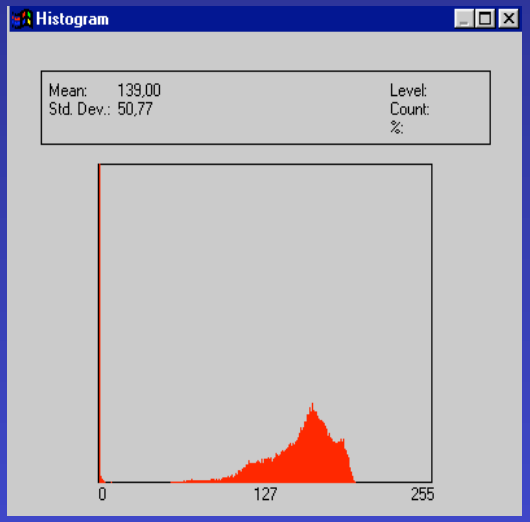
- Quality assurance
- Diagnostic work
- Follow up examination

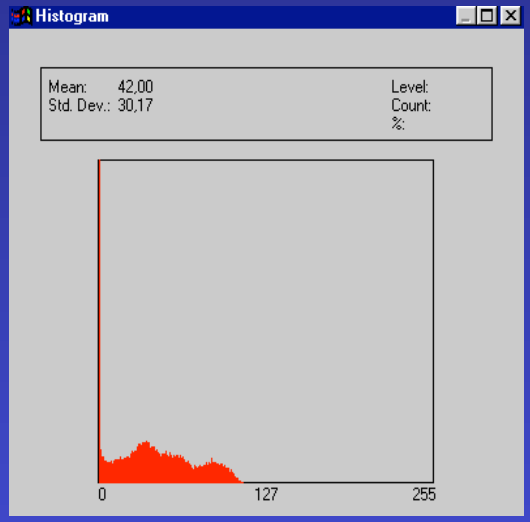
Quality assurance

- histogram
- Changing density
  - Correcton of T_{exp} error
- Changing contrast
  - manual = individual
  - automatic = objective
    - Contrast streching

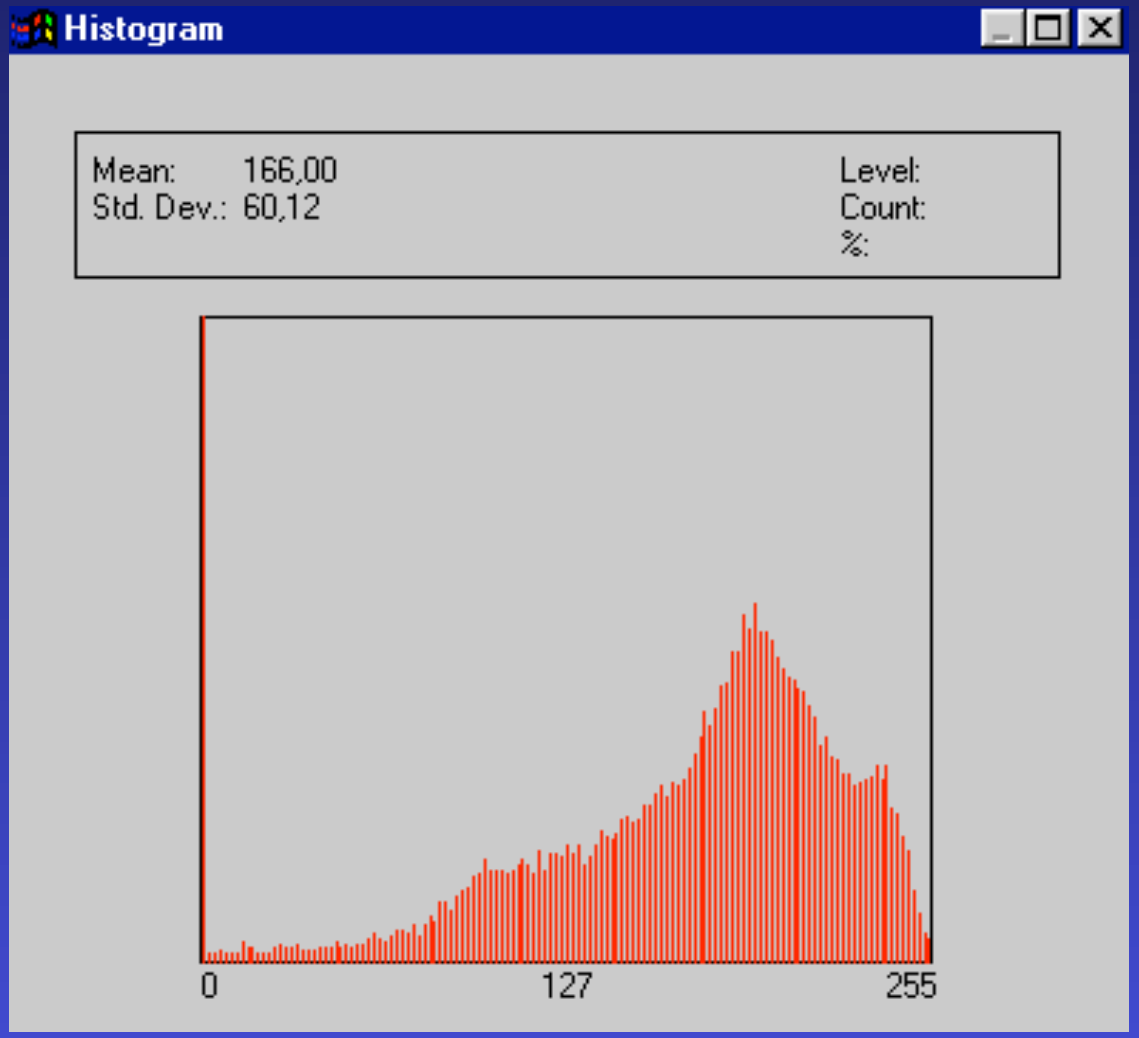
Histogram


Histogram
Mean: 179,00
Std. Dev.: 44,68
Level:
Count:
%:
0
127
255


Histogram
Mean: 139,00
Std. Dev.: 50,77
Level:
Count:
%:
0
127
255

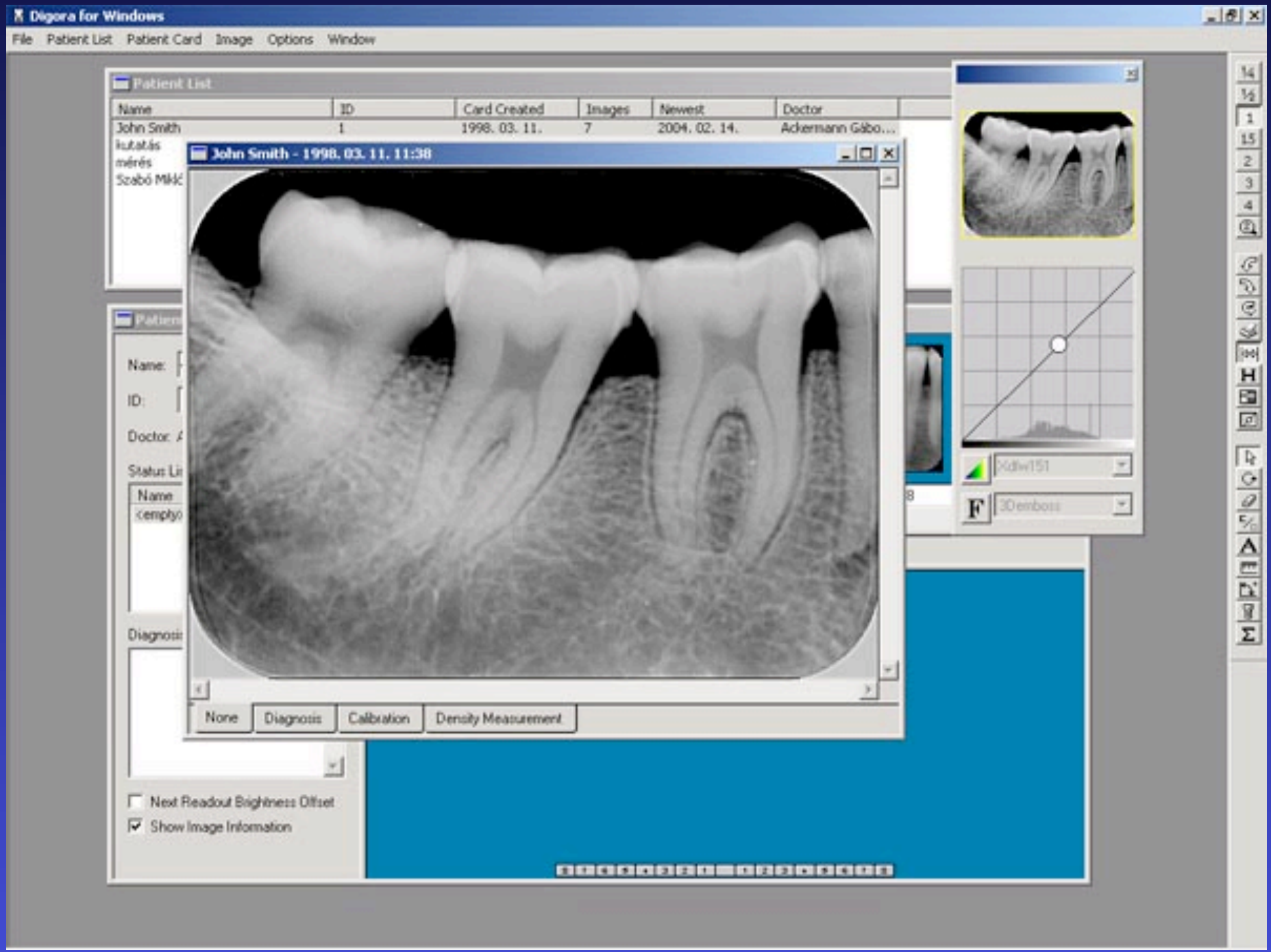

Histogram
Mean: 42,00
Std. Dev.: 30,17
Level:
Count:
%:
0
127
255

Contrast streching



Diagnostic work

- contrast/density change
- Magnification
- Inverse picture
- Edge enhancement
- Nois reduction
- Mesure
- Colorisation


Digora for Windows
File Patient List Patient Card Image Options Window
Patient List
Name ID Card Created Images Newest Doctor
John Smith 1 1998. 03. 11. 7 2004. 02. 14. Ackermann Gábo...
John Smith - 1998. 03. 11. 11:38
None Diagnosis Calibration Density Measurement
Name:
ID:
Doctor:
Status Li
Name
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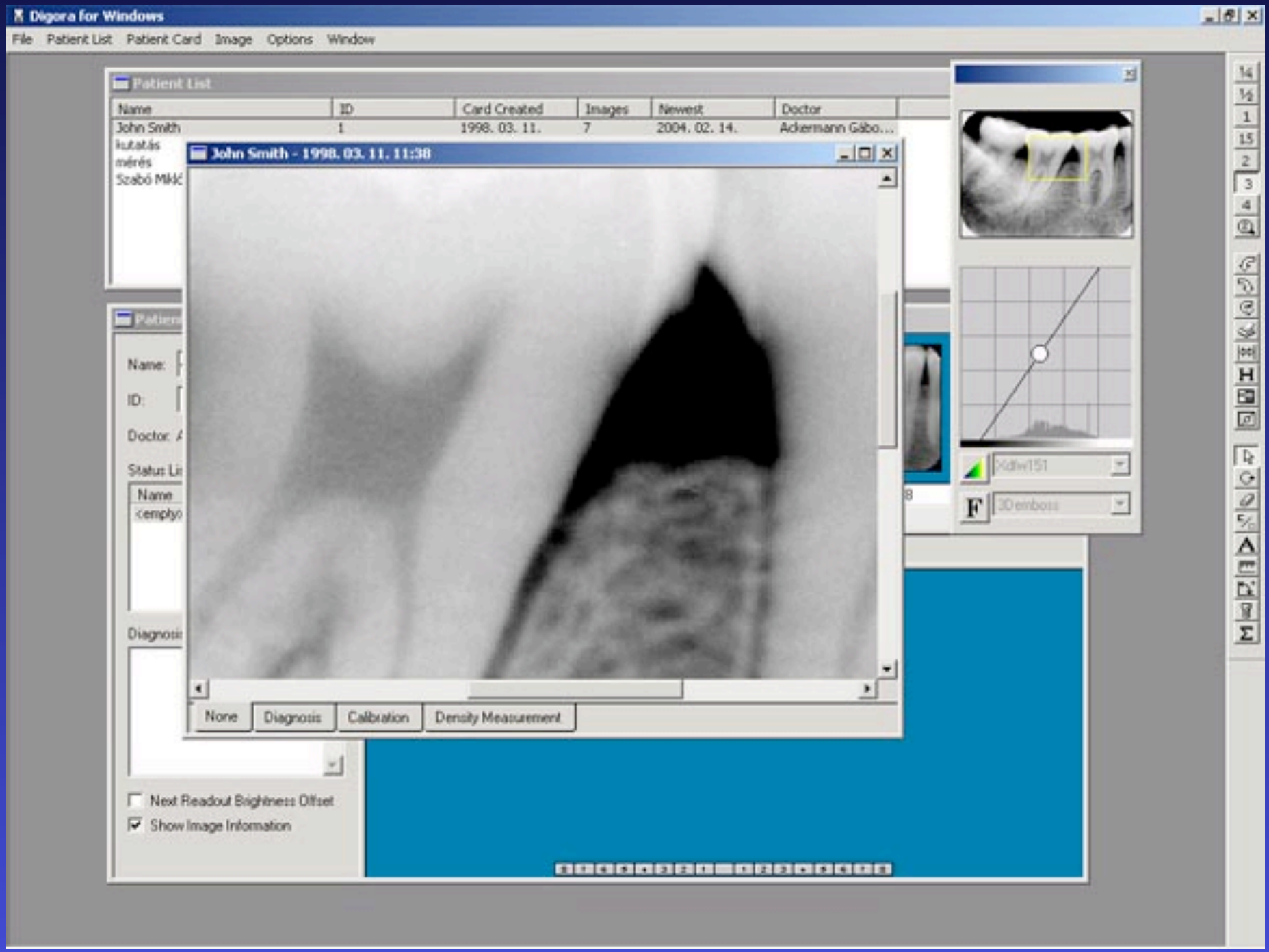
Diagnosis
Next Readout Brightness Offset
Show Image Information
Xdlw151
3Demboss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Patient List
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John Smith 1 1998. 03. 11. 7 2004. 02. 14. Ackermann Gábo...
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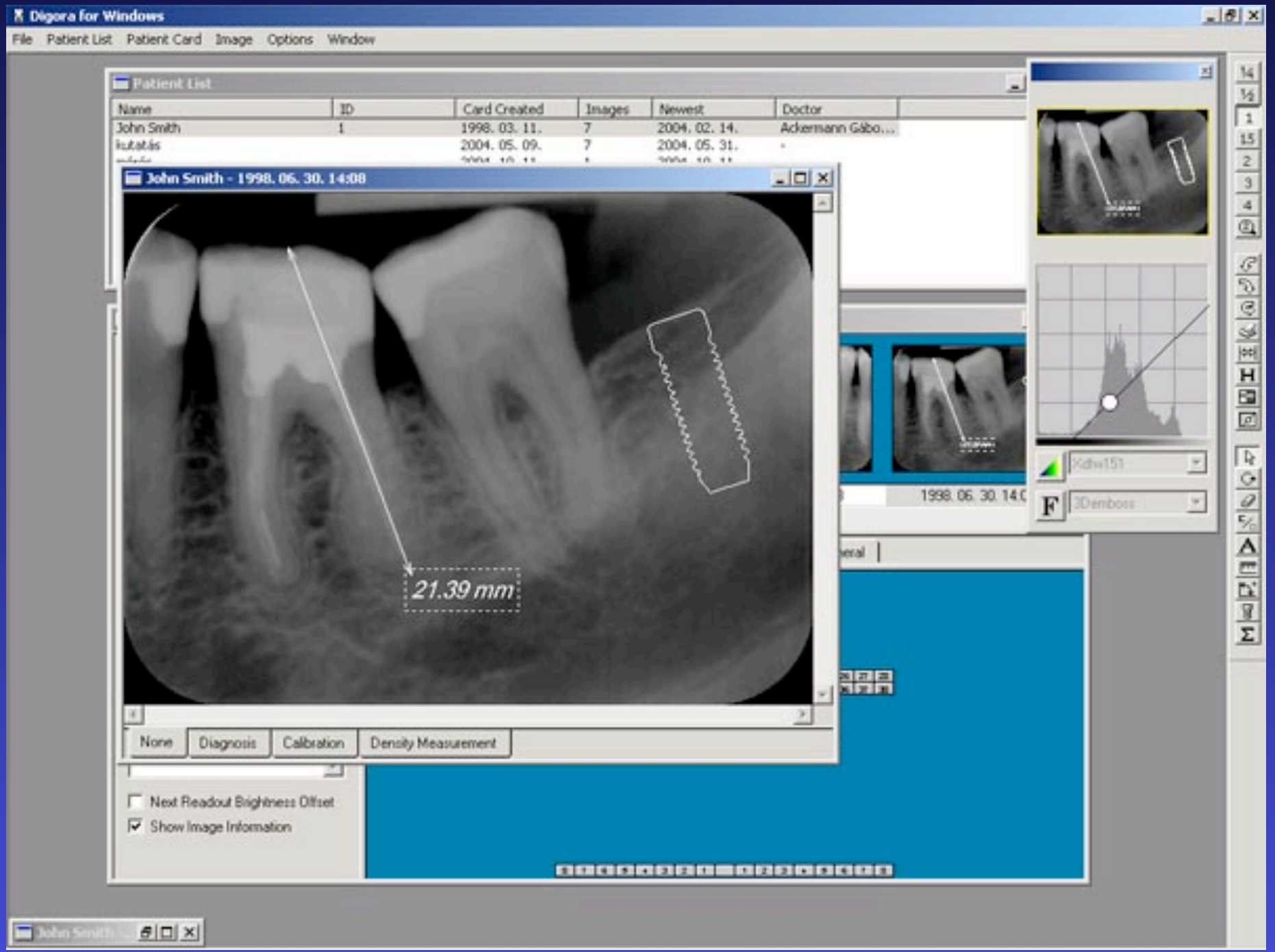
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Patient List
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Options
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Patient List
Name
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Newest
Doctor
John Smith
1
1998. 03. 11.
7
2004. 02. 14.
Ackermann Gábo...
2004. 05. 09.
7
2004. 05. 31.
John Smith - 1998. 06. 30. 14:08
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Diagnosis
Calibration
Density Measurement
Next Readout Brightness Offset
Show Image Information
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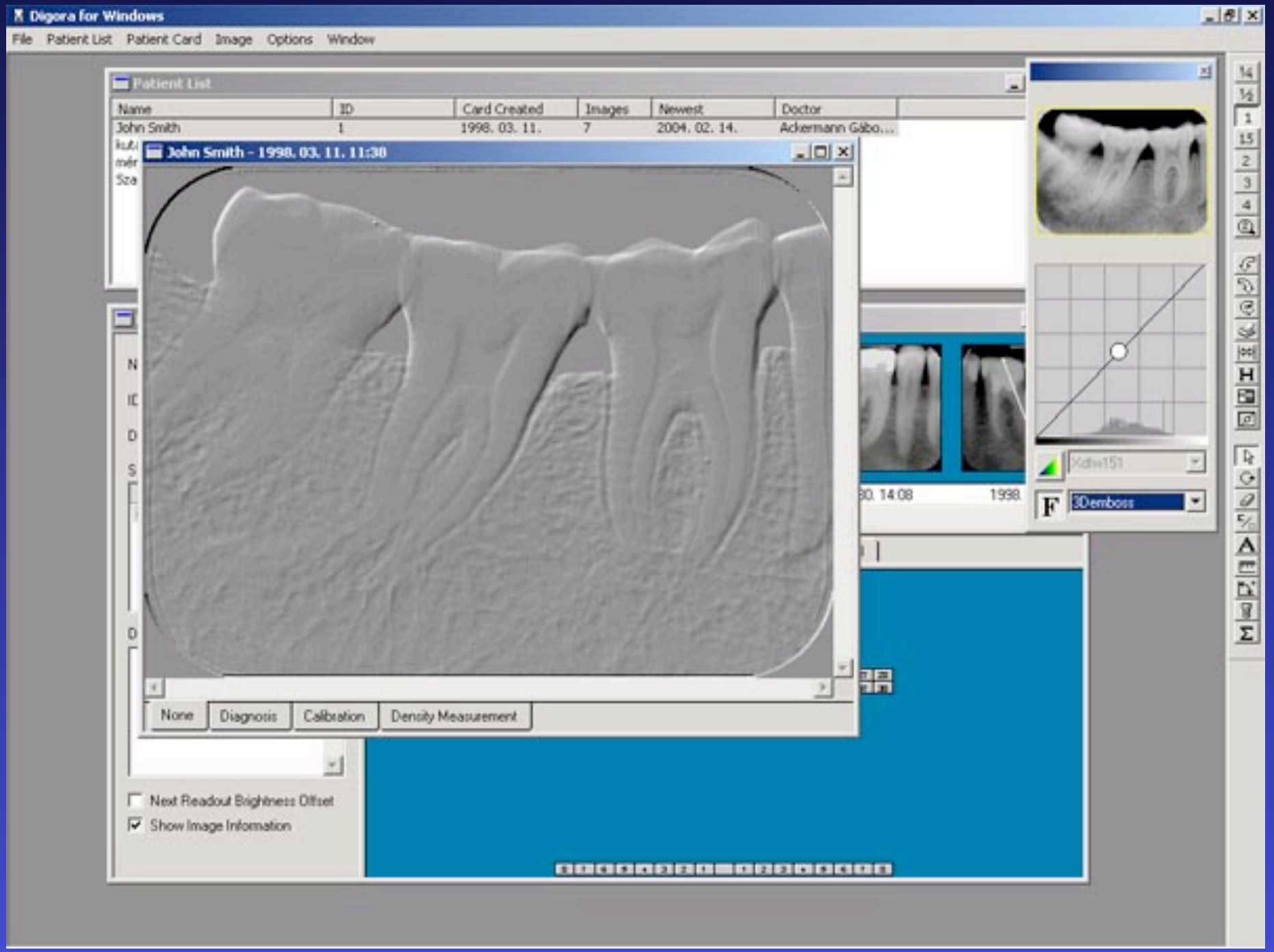
3Demboss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Options
Window
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Name
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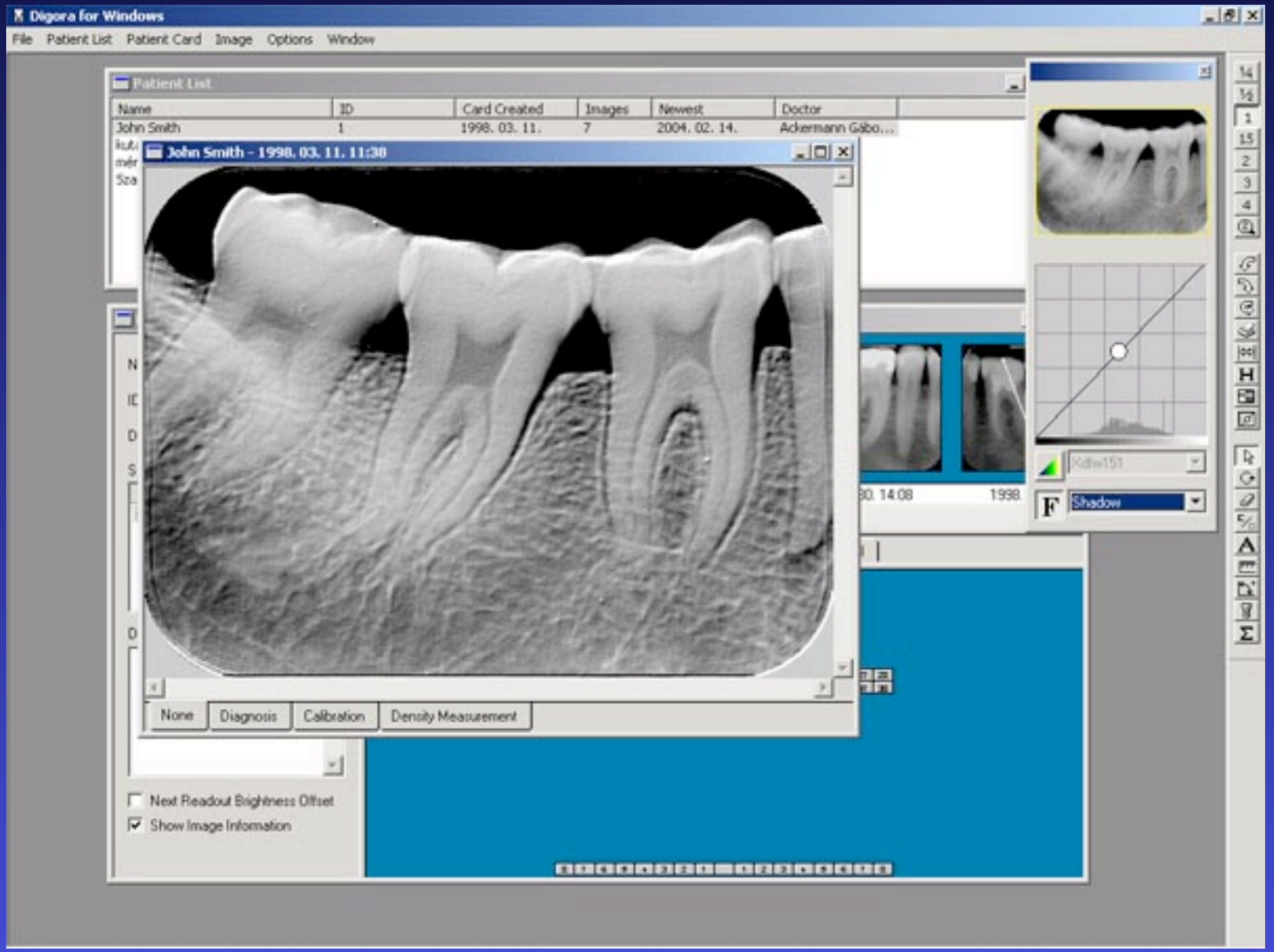
Card Created
Images
Newest
Doctor
John Smith
1
1998. 03. 11.
7
2004. 02. 14.
Ackermann Gábo...
John Smith - 1998. 03. 11. 11:30
None
Diagnosis
Calibration
Density Measurement
3Demboss
Next Readout Brightness Offset
Show Image Information

Task specific postprocessing

- **Caries search**
  - contrast/density optimalizing
  - Edge enhancement
- **Marginal periodontium**
  - contrast/density optimalizing
  - Positive view
- **Periodontal membraine space**
  - Positive view
- **Periapical area**
  - Positive view


Digora for Windows
File
Patient List
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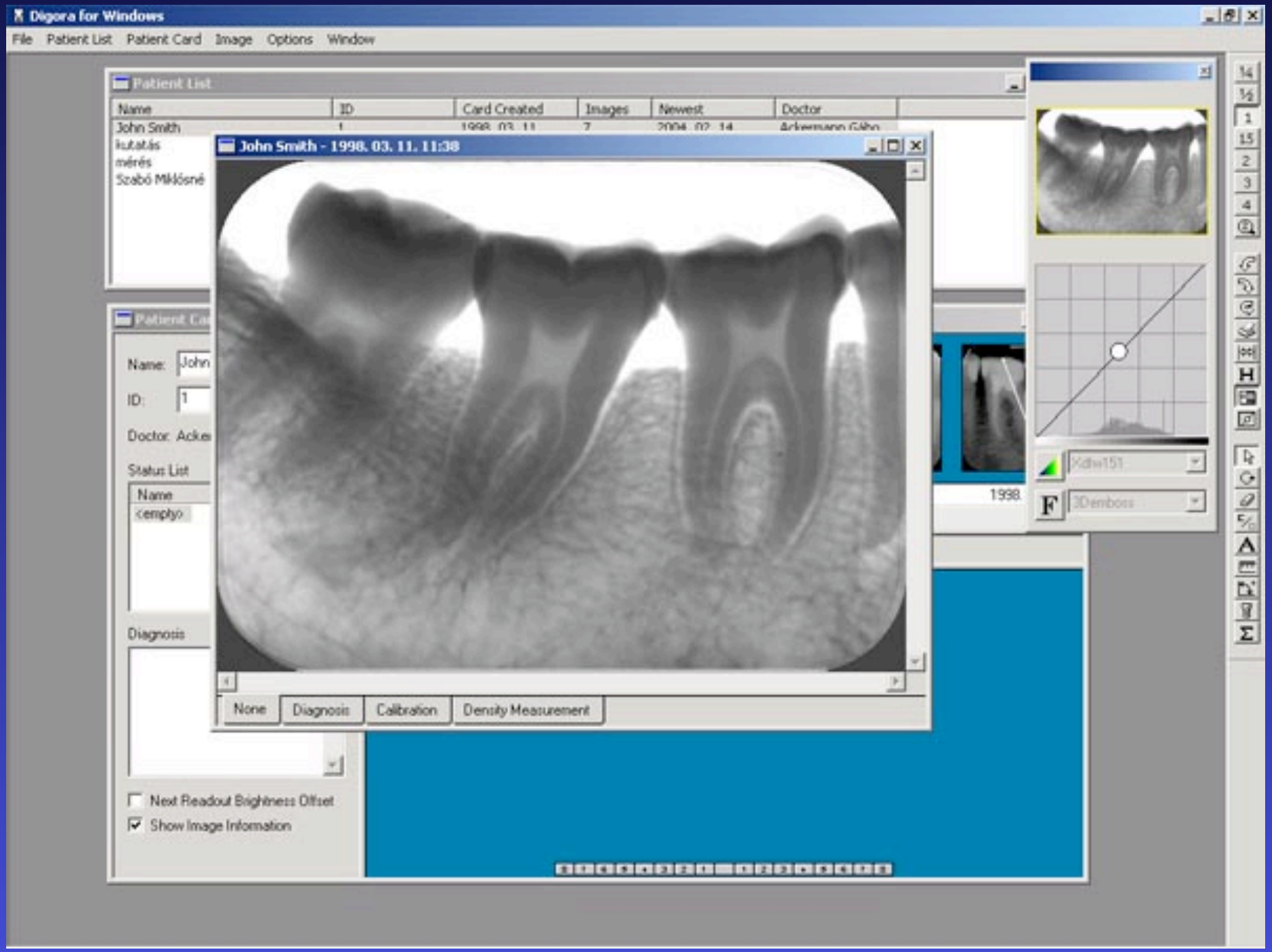
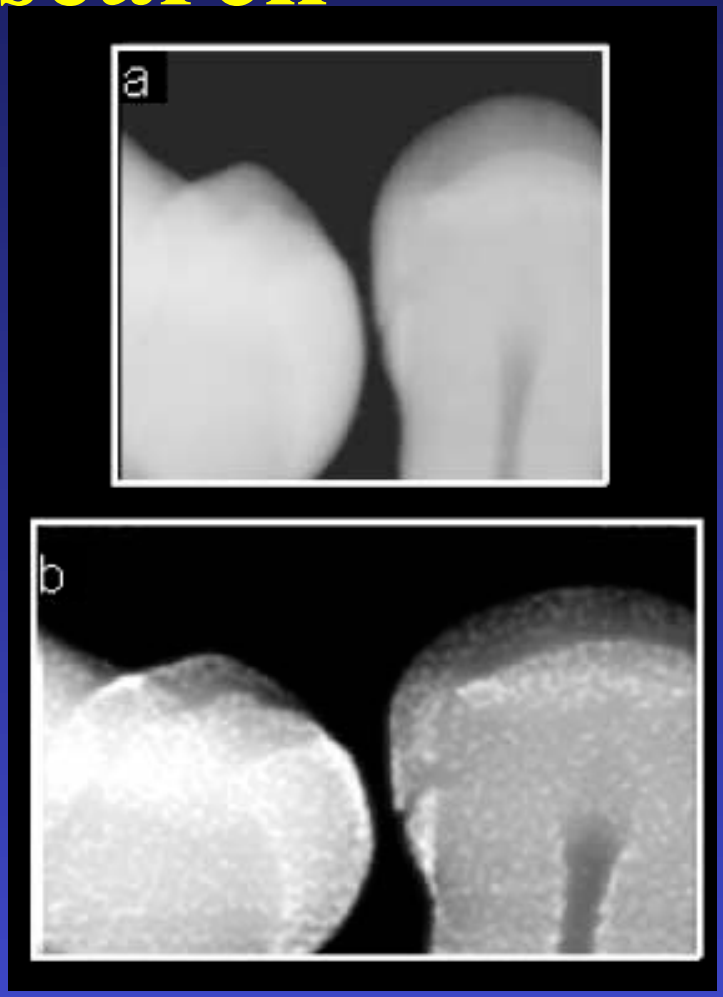
Options
Window
Patient List
Name
ID
Card Created
Images
Newest
Doctor
John Smith
1
1998. 03. 11.
7
2004. 02. 14.
Ackermann Gábo...
John Smith - 1998. 03. 11. 11:30
None
Diagnosis
Calibration
Density Measurement
Next Readout Brightness Offset
Show Image Information
Shadow

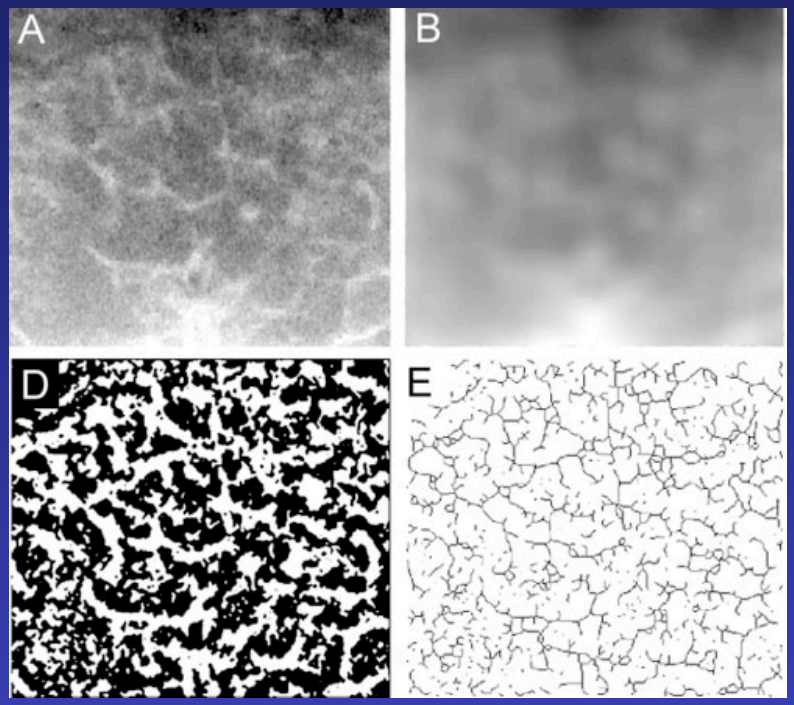

Digora for Windows
File Patient List Patient Card Image Options Window
Patient List
Name ID Card Created Images Newest Doctor
John Smith
kutatás
mérés
Szabó Miklósné
John Smith - 1998. 03. 11. 11:38
Name:
ID:
Doctor:
Status List
Name
<empty>
Diagnosis
Next Readout Brightness Offset
Show Image Information
None
Diagnosis
Calibration
Density Measurement
1998
3Demboss

Caries search

- Oslo-enhancement method
  - sharpening
  - contrast streching
  - gamma correction
  - horizontal image correction



Osteoporosis

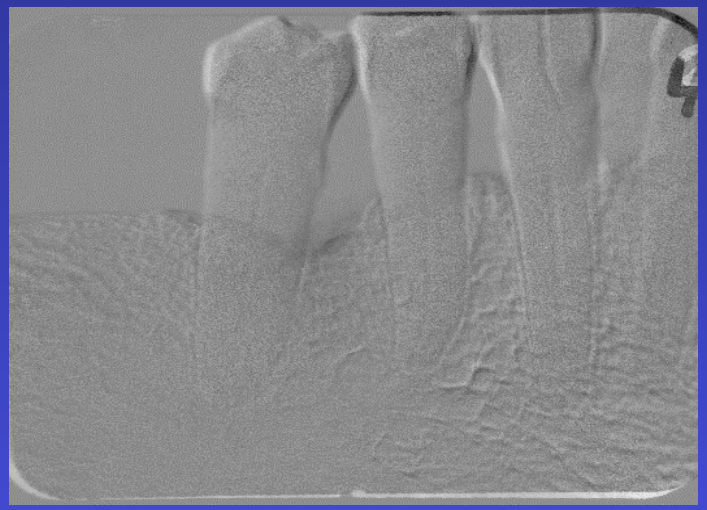


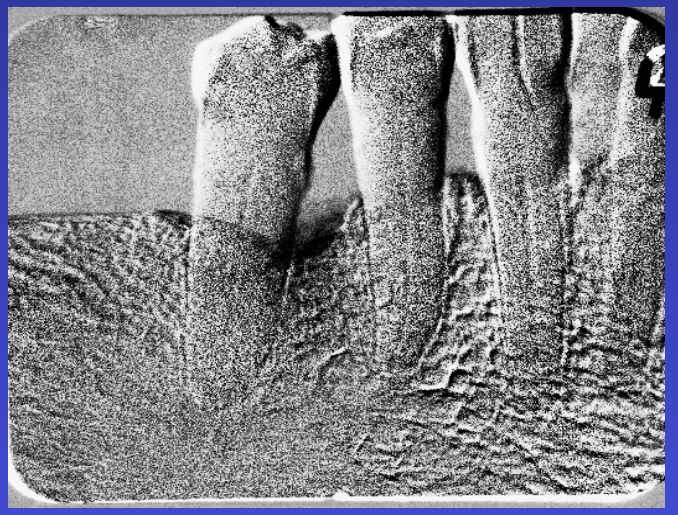
A: original image, B: blurring, C: A-B,
D: Black and white transformation
E: sceletonisation, F:A+E

Long term follow up

- gamma correction
  - equalizing density
- geometric reconstruction
  - Correction of imaging errors
- digital substraction radiography
  - Display the difference

DSR






Thank you
for your
attention!